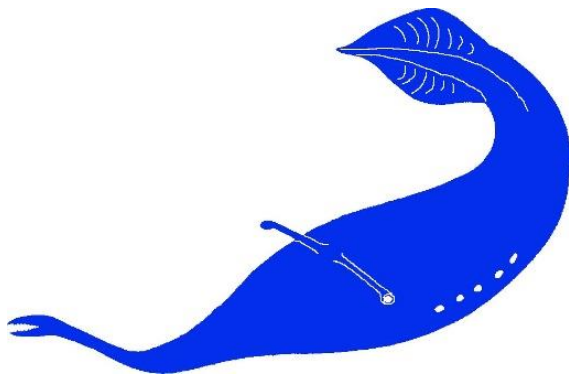




Program & Abstracts

Making the Case for Natural History Collections



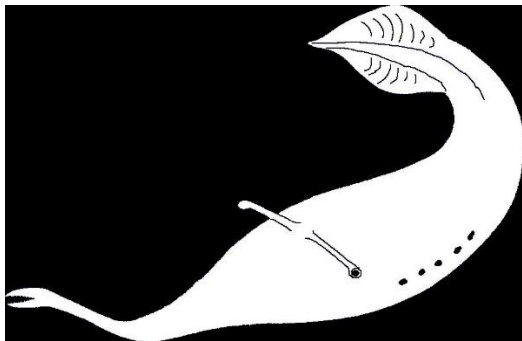
**34th Annual Meeting of the
Society for the Preservation
of Natural History Collections**

May 25-31, 2019

The Field Museum, Chicago, Illinois



Program & Abstracts
Making the Case for Natural History Collections



**34th Annual Meeting of the
Society for the Preservation
of Natural History Collections**

May 25-31, 2019
The Field Museum, Chicago, Illinois

Edited by Paul S. Mayer and Theresa Reilly

SPNHC 2019 Local Organizing Committee

Paul Mayer, Chair
John Bates
Mark Bouman
Christine Giannoni
Janeen Jones
Christine Niezgoda
Theresa Reilly

SPNHC President

Barbara Thiers

Special Thanks to

The SPNHC 2019 Local Organizing Committee wishes to express their appreciation and gratitude to all those that helped make this meeting possible. We are truly grateful for your help and time.

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And all the Field Museum staff and volunteers who have donated their time and energy to the conference.

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Welcome to SPNHC 2019 from Your Chicago Hosts

Dear 2019 Conference Attendees,

Welcome to the Midwest, Chicago, and the 34th annual meeting of the Society for the Preservation of Natural History Collections. The Field Museum is extremely excited to host this year's meeting. The Field Museum hosted the 5th annual SPNHC meeting in 1990. That meeting included 12 posters and 31 presentations. Today's meeting has more than quintupled in size with 66 posters and 161 abstract presentations plus 70 specimen spotlights; all testifying to the growth and success of SPNHC over last 29 years.

This year's conference theme is "*Making the Case for Natural History Collections*". As more effort and resources are spent on digitizing collections and making them available to an ever expanding audience we feel it becomes more and more important to explain what museum collections are, how we preserve them, and most importantly why we have these collections and why they matter. New to this meeting is a session called Specimen Spotlight. This is a chance for everyone to highlight one specimen in their collection and explain why that specimen is special and what makes it important. My hope is that these short, five-minute, one-slide presentations will allow everyone to participate at the meeting and when viewed as a group these spotlights will demonstrate the diversity, importance, and greatness of museum collections that we, as collection workers, already understand.

While the focus of the meeting is the talks and poster presentations, perhaps just as important is the networking and informal conversations that allow people to ask questions and lead to sharing experiences, new ideas, and developing partnerships. I strongly encourage everyone to take part in at least some of the afterhours social activities including: the opening cocktail reception, trivia night, the vendors Lake Michigan cruise, and the annual banquet.

Also please take time to thank our partners and sponsors for this conference or better yet patronize them. Without their support this meeting would not be possible.

The local organizing committee members have all worked very hard in putting this meeting together and we hope you have a productive and memorable meeting and a truly wonderful time in Chicago.

Paul Mayer
Chair of the Local Organizing committee



Welcome to SPNHC 2019

Dear SPNHC Conference Attendees:

It is my pleasure to welcome you to the 34th annual conference of the Society for the Preservation of Natural History Collections! Our meeting, held 25-31 May 2019 in Chicago Illinois, is going to be an unforgettable experience. Our venue is the Chicago Hilton on Michigan Avenue, one of Chicago's most famous hotels. It was built in 1927 (originally called the Stevens Hotel), and every president of the U.S. since that time has stayed here on visits to the Windy City! The hotel is very close to the Field Museum, our host for the conference. Growing from a display of 65,000 natural wonders and curiosities at the 1893 World's Columbian Exposition, the Field Museum today houses some 40 million artifacts, and a world class scientific and collections management staff. Some of those excellent professionals make up our Local Organizing Committee. Led by Paul Mayer, this amazing team, including John Bates, Mark Bouman, Christine Giannoni, Janeen Jones, Christine Niezgoda and Theresa Reilly, has arranged a wonderful and very full program of events.

Maybe I'll run into you at one of the pre-conference field trips or workshops! There are so many to choose from. The trips include visits to Horicon Marsh, Mazon Creek, and the Milwaukee Public Museum. If you decide to stay in town for the weekend, you will have your choice of workshops in ivory conservation, 3D photogrammetry, grant writing, illustrating, data preparation and export, integration of collections as educational resources, how to make the case for your collection, and how to safely import of potentially infectious organisms.

Our paths will likely cross at the plenary talks—we have an exceptional lineup: Kirk Wallace Johnson, author of *The Lost Species*, Kyle Copas, of the Global Biodiversity Information Facility (GBIF), and noted natural history artist Peggy McNamara. In true SPNHC style, we have many wonderful opportunities to relax and enjoy one another's company as well. We have the welcome reception on Monday night, trivia night and pizza on Tuesday, the Emerging Professionals luncheon and the vendor reception on the Mystic Blue Cruise on Wednesday, the Conference Banquet in Stanley Field Hall on Thursday, and if you aren't completely exhausted after all of that, there is the informal farewell evening at Vice Brewery on Friday.

After perusing the fascinating abstracts in this volume, you will fill up your day time schedule with paper sessions and symposia, but also please do make time to support your society by joining a SPNHC committee meeting on Tuesday afternoon, the Annual Business Meeting on Friday, the Educational Share Fare, Special Interest Group meetings, and the collections tours at the Field Museum.

In keeping with the strong tradition at SPNHC of support Emerging Professionals, I am delighted to announce that due to the efforts of Kari Harris, Chair of our Emerging Professionals Committee and Travis Marsico, we again will have participation by 45 attendees who are affiliated with the Natural History Collections Network. This total includes 12 faculty members or advisors, 17 graduate students and 16 undergraduate students. Of the 16 colleges and universities represented, nine are completely new to the network and another three are new to SPNHC. Be sure to attend their presentations, and take the time to welcome them to our Society.

The theme of this year’s conference, *Making the Case for Natural History Collections*, could not be more timely—we all must continue to improve our narrative about the importance of natural history collections for addressing future challenges. Whether you are an emerging or seasoned professional, you will certainly take home many great ideas for supporting your own collection, and a bunch of new friends and colleagues to follow on social media!

Barbara Theirs
President SPNHC



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SPNHC Annual Meeting Travel Grants

The Society for the Preservation of Natural History Collections (SPNHC) has a Travel Grant program designed to assist members with the costs of attending the Society's annual meetings.

This year the SPNHC Annual Meeting Travel Grant program consisted of two grant categories--The **Fitzgerald Travel Grant** and the **Christine Allen Travel Grant**.

Thank you to our generous donors, including University Products, Gaylord Brothers, Hollinger Metal Edge (the Christine Allen Travel Grant), and private individuals.

2019 SPNHC Annual Meeting Travel Grant Recipients

Fitzgerald Travel Grant Recipients

Erin Berkowitz
Rancho Santa Ana Botanic Garden

M. Alejandra Camacho
Zoology Museum, Pontifical Catholic University of Ecuador

Andrés Julián Lozano Flórez
Instituto de Investigación de Recursos Biológicos Alexander von Humboldt

Laurel Kaminsky
McGuire Center for Lepidoptera and Biodiversity, Florida Museum of Natural History

Christine Allen Travel Grant Recipient

Irene Finkelde
National Museum of Natural History, Smithsonian Institution

Chicago
“Hog Butcher for the World,
Tool Maker, Stacker of Wheat,
Player with Railroads and the Nation's Freight Handler;
Stormy, husky, brawling,
City of the Big Shoulders”
Excerpt from *Chicago* by Carl Sandberg

We are delighted to welcome you to Chicago and to the 34th annual meeting of the Society for the Preservation of Natural History Collections. The Field Museum is proud and honored to host this conference and hopes that not only will you be able to share your stories, learn from your colleagues and make new connections in your personal networks, but also enjoy some of the entertainment and rich culture that the city of Chicago offers.

We also wish to thank all the sponsors, vendors and partners, who have made this meeting possible.

Conference Partners



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General Conference Information

Conference Venue and Accommodations

Chicago Hilton
720 S. Michigan
Chicago, IL 60605
(312) 922-4400
www.chicagohilton.com

Field Museum
1400 S. Lake Shore Drive
Chicago, IL 60605
312.922.9410
www.fieldmuseum.org

Additional Accommodations
University Center
525 S State St
Chicago, IL 60605
(312) 270-2311
www.universitycenter.com

A majority of the conference will take place at the Chicago Hilton. Conference Presentations will be held in the Continental Rooms A, B and C, with additional activities taking place in the Waldorf Room. Poster sessions will be held in the Astoria Room. Sponsors and Vendors will be located in the Williford Room on Wednesday morning through Thursday afternoon.

Registration Desk

Please visit the registration desk at the 8th Street Entrance on the Lobby Level of the Chicago Hilton to pick up your name badge, conference tote and tickets for the social events. Badges are required for the conference and should be worn at all times and at all conference events including social activities at the Chicago Hilton, Revolution Brewery, Mystic Cruise and Field Museum.

Sign-up sheets for Special Interest Groups (SIGs) and Field Museum Collection Tours will be located at the registration desk. You can also register for any social events, workshops or field trips that still have openings when you check in.

Registration and Information Desk hours are:

Monday, May 27: 7:00am - 6:00pm
Tuesday, May 28: 7:00am - 9:00am then from 2:00pm - 6:00pm
Wednesday, May 29: 7:00am - 6:00pm
Thursday, May 30: 7:00am - 6:00pm

Oral Presentations

The normal length of an oral presentation is 12 minutes plus three minutes for questions and answers. You may use all 15 minutes to present your talk.

Most General Session and Symposium talks will be in one of the three Continental Ballrooms (A, B, or C) on the ground floor or in the Waldorf Room on the third floor of the Chicago Hilton.

You must visit the Speaker Ready Room at least 24 hours before your scheduled session to upload your presentation for your scheduled room. Presentation slides should be saved as a PowerPoint widescreen 16:9 ratio or as a PDF. You may upload your PowerPoint to your OSF page.

Please check that all fonts are working (try to use commonly used fonts). Check that all images are displayed correctly and that any videos are working correctly. Bring copies of all images and videos in case there are any problems.

Please use the following format to name your file before visiting the Speaker Ready Room:

Date of presentation_Time of presentation (please use military time)_Last Name_Symposium designation

Example: 53019_1330_Mayer_SY05

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Demo Camp

All Demo Camp presentations will be in the Waldorf Room of the Chicago Hilton. Presentations are limited to 30 minutes.

The Chicago Hilton will be providing WiFi for all presentations.

Speaker Ready Room Hours

The Speaker Ready Room is located near the Registration Desk at the 8th Street Entrance on the Lobby Level of the Chicago Hilton. Speakers must visit the Speaker Ready Room at least 24 hours before your scheduled session to upload your presentation for your scheduled room. It's best to make sure images and fonts used in your presentation are embedded in your presentation to ensure a seamless talk. Highly qualified technicians will be on-hand to offer any needed assistance.

Monday, May 27: 3:00 pm - 7:00 pm

Tuesday, May 28: 3:00 pm - 7:00 pm

Wednesday, May 29: 8:00 am - 5:30pm

Thursday, May 30th: 8:00 am to Noon

Poster Presentations

You will be provided with one horizontal, freestanding 36" by 48" piece of foam core board resting on an easel. You may choose to mount your poster in landscape or portrait orientation. Velcro, tape, and thumbtacks for hanging your display will be provided for all poster presenters.

Posters should be on display from 8:00 am to 5:30 pm during the day of your poster presentation.

Poster Session 1, Wednesday, May 29

Set Up: Tuesday, May 28th, after the Plenary Session between 2:00 pm and 5:00 pm OR Wednesday May 29th, between 7:00 am and 8:00 am

Take Down: between 4:30pm - 5:00 pm on Wednesday

Poster Session 2, Thursday, May 30

Set Up: Wednesday, May 29th between 5:00pm - 5:30pm OR Thursday, May 30th, between 7:00 am and 8:00 am

Take Down: between 4:30pm - 5:00pm on Thursday

We request that Poster Presenters be at their posters during the coffee breaks, lunch breaks and near the end of the sessions on your designated day to answer questions.

Specimen Spotlight Presentations

Specimen Spotlight presentations are 5 minutes long with no time for questions.

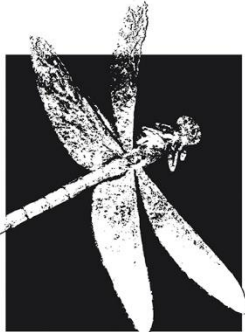
All Specimen Spotlight Presentations will be in the Waldorf Room on the third floor of the Chicago Hilton.

There will be a title slide and an image slide. All slides will be prepared and uploaded ahead of time by the conference organizers. Your title and image slide will be prepared for you from the image and data you submitted on the conference website's google form when you submitted your Specimen Spotlight title.

You may visit the Speaker Ready Room prior to your presentation to view your slide. Changes must be done 24 hours in advance.

Please try to arrive to Waldorf Room at least 15 minutes prior to your presentation and sit near the front to save time between presentations.

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2019 Annual Meeting Code of Conduct

The 2019 Annual Meeting of the Society for the Preservation of Natural History Collections (SPNHC) will take place in Chicago, Illinois, USA May 26-30, 2019. By registering for the meeting and/or participating in any workshops, panels, or other activities associated with this conference, you agree to the following Code of Conduct:

Authors: Authors of presentations and workshops should conform to the highest standards of scientific attribution and citation in their presentations and other materials submitted. All authors connected to a presentation and associated abstract must be aware of and agree with the information presented. Obtaining consent from all authors to be associated with the presentation is the responsibility of the lead and presenting author(s).

An author who submits an abstract for presentation at this conference must have intention of registering, attending, and presenting at the meeting once the submission is accepted into the program. Authors must abide by any submission deadlines, presentation time limits, or other format-related instructions provided by the meeting's organizers.

All authors must complete a Speaker Release form prior to their presentation, allowing SPNHC to record the presentation for non-commercial educational and outreach purposes.

Harassment and Safety: SPNHC is dedicated to providing a safe, hospitable, and productive environment for everyone attending their events, regardless of ethnicity, national origin, religion, disability, physical appearance, sex, gender expression, or sexual orientation. It is important to remember that a community where people feel uncomfortable or threatened is neither healthy nor productive. Accordingly, SPNHC prohibits intimidating, threatening, or harassing conduct during our conference. This policy applies to speakers, staff, volunteers, and attendees. Conference participants violating these rules may be sanctioned or expelled from the conference, at the discretion of leadership.

Harassment of participants at SPNHC-sponsored events will not be tolerated in any form. Harassment includes offensive gestures or verbal comments related to ethnicity, national origin, religion, disability, physical appearance, sex, gender expression, or sexual orientation in public spaces, deliberate intimidation, stalking, following, harassing photography or recording, sustained disruption of talks or other events, inappropriate physical contact, and unwelcome attention. Participants asked to stop any harassing behavior are expected to comply immediately.

If a participant or exhibitor engages in harassing behavior, conference leaders may take any action they deem appropriate, ranging from a simple warning to expulsion from this and future conferences. If you are being harassed, need to file a complaint, or have other concerns about the safety of participants, please do not hesitate to contact one of the conference organizers who will work with you to resolve the situation.

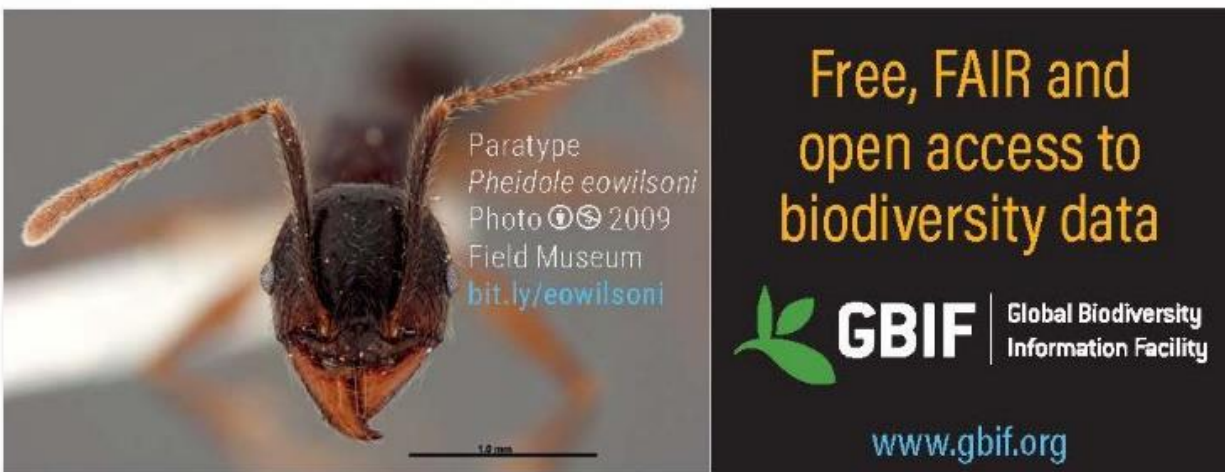
We will help participants contact venue or hotel security or local law enforcement, and otherwise assist those experiencing harassment, to enable them to feel safe for the duration of the

conference. We value your attendance, and want to make your experience as productive and professionally stimulating as possible.

Photography and Image Release: Participants may not take photographs or videos that may be disruptive to presenters (flash; shutter sounds; distracting presence) during sessions.

The nature and mission of SPNHC's activities is to reach as broad an audience as possible. To this end, not only are abstracts published, but presentations (audio/video, slides, and posters) themselves and conference events may be photographed, streamed, recorded, and made publically available. Both SPNHC and the Field Museum of Natural History (the 2019 Annual Meeting's host) reserve the right to use photographs and videos taken and testimonials given during any conference event or in subsequent meeting surveys for educational, reporting, promotional, advertising, and fundraising purposes; you agree that SPNHC and the Field Museum may use your name, voice, and likeness as captured in such recording for these purposes.

Personal Data: During the registration process and conference, SPNHC may need to collect personally identifiable information from you. SPNHC will use your personal data only for the purposes of conference registration, organization, and communication with conference organizers. SPNHC may also contact you about future meetings or community events that may be of interest to you; you can opt out of these communications at any time. SPNHC will share your personal data with third parties only to the extent necessary for such third parties to carry out the above purposes on SPNHC's behalf.



Social Media

Our Twitter hashtag is: #SPNHC2019

Our Facebook Page is: Chicago SPNHC 2019

Plenary Session and Lunch

The Plenary Session will take place in the Grand Ballroom on the Second Floor at the Chicago Hilton on Tuesday, May 28th. The Plenary session will begin at 9:00am. Lunch will be served in the Grand Ballroom following the conclusion of the presentations. Please note that the Registration Desk will be closed from 9:00am to 2:00pm this day.

SPNHC Committee Meetings

Committee meetings for the SPNHC Council will be held on Tuesday, May 28th, following the plenary session and lunch at the Chicago Hilton. All Committee Meetings will take place in the PDR (Private Dining Rooms) located on the 3rd Floor. Please refer to the schedule in this program for exact times and room locations.

All attendees to the conference are welcome to attend these committee meetings.

Annual Business Meeting

The Annual Business meeting will take place at the Field Museum's Simpson Theater on Friday, May 31st at 11:30am. Lunch will be provided after the meeting concludes.

Special Interest Groups (SIGS)

Special Interest Groups will meet from 8:00am - 11:00am on Friday, May 31st at the Field Museum. To attend one of the below events, please sign up at the Registration Desk before Thursday, May 30th.

Avoiding Carcinogen Exposure
Field Museum - 9:30am - 10:30am

Science through Story: Engaging Broad Audiences
Field Museum - 9:30am - 11:00am

Behind-the-Scenes Collections Tours

After the Annual Business Meeting and Lunch, you will have the chance to tour the Field Museum's Collections and the Collections Resource Center. Collection staff will conduct timed entry tours. All attendees wishing to join a tour must sign up at the Registration Desk prior to Thursday, May 30th. Collection Tours will include: Anthropological Collections, Botanical Collections, including the Herbarium, Geological Collections, Zoological Collections, including our prep labs and tours of the Field Museum's outdoor gardens.

Social Events

All social events are ticketed events and require pre-registration. Tickets and conference badges will be required when checking into each event.

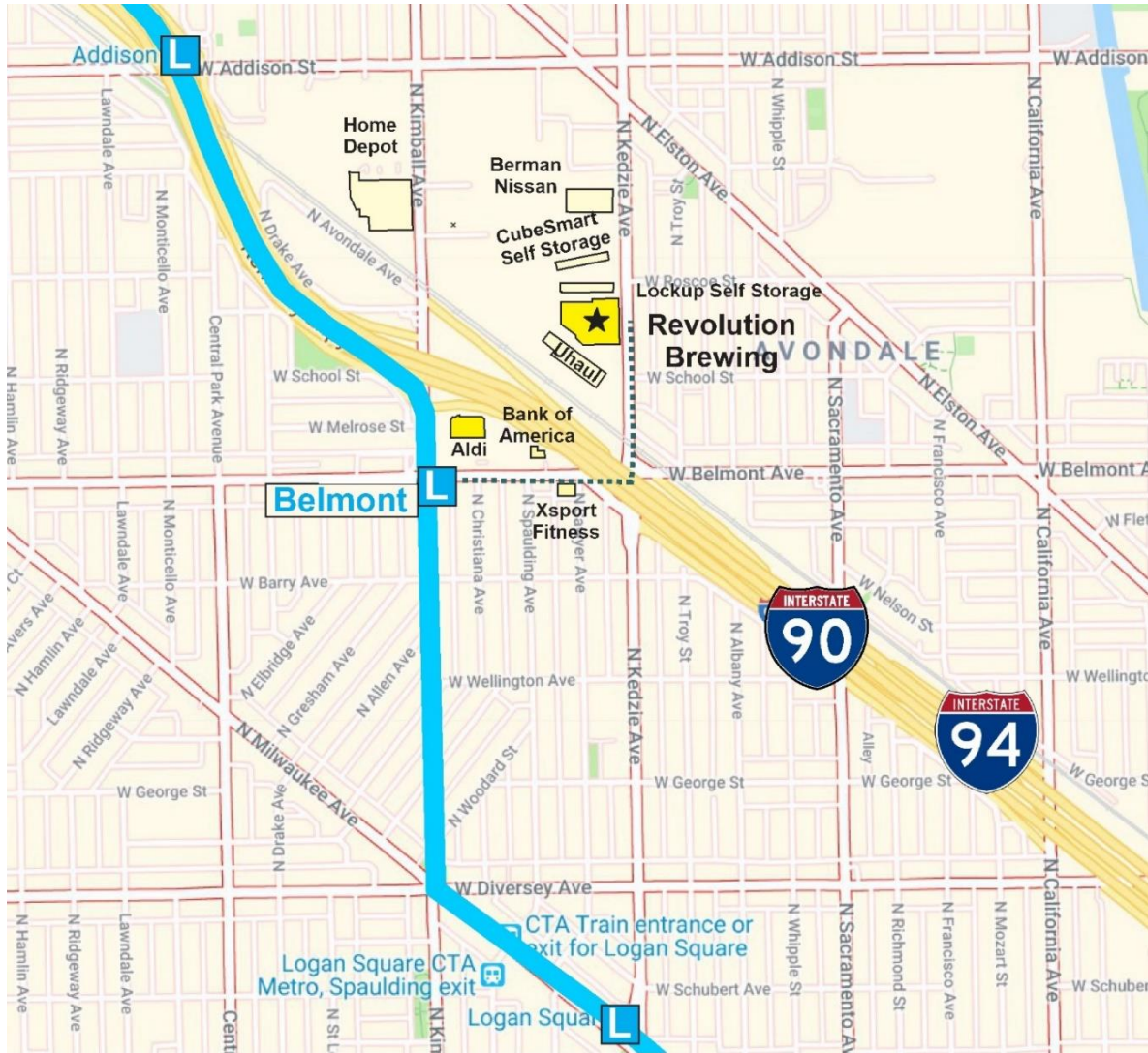
Welcome Reception

The Welcome Reception will be held in the Normadie Lounge, located on the Second Floor of the Chicago Hilton from 6:00pm - 8:00pm. Drinks and hors d'oeuvres will be served. Be certain to have picked up your registration materials including your badge and ticket to this event.

Trivia Night

Trivia Night will take place at Revolution Brewery, located at 3340 N. Kedzie Ave, Chicago, IL 60618. Groups will meet in the Hilton Lobby to travel there together by the 'L' (blue line train LaSalle to Belmont) or feel free to travel there using your own transportation, Lyft, Uber, or taxi.

Tours of the brewery will be available before and after the trivia contest. For dinner there will be a selection of pizzas from across Chicago. Taste and compare some of Chicago's finest pizzas and learn about both styles of pizza that Chicago invented, Deep Dish and Stuffed. Prizes will be awarded to the top winning teams. Tickets are required for check in, and may be purchased a registration desk if there are still openings.



Emerging Professional Luncheon

New participants to the SPNHC conference are welcomed to this luncheon where you can meet and network with other emerging natural history professionals. Lunch will be in the Marquette Room on the Third Floor of the Chicago Hilton. The luncheon will take place from Noon until 1:30pm. Tickets will be required for check-in.

Vendor Reception

The Vendor Reception will take place aboard the Mystic Blue Cruise Ship departing from Chicago’s family Navy Pier, located at 600 E Grand Ave, Chicago, IL 60611. Feel free to travel to Navy Pier on your own by using Lyft, Uber or a taxi. Individuals interested in traveling to Navy Pier by shuttle bus can meet at the 8th Street entrance on the Lower Lobby of the Chicago Hilton. The shuttle will run from the hotel to Navy Pier from 5:00pm until 6:30pm. Boarding of the Mystic Cruise will begin promptly at 6:30pm with final boarding at 6:55pm. The ship will depart Navy Pier at 7:00pm.

The Mystic Cruise will have a buffet dinner, open bar, DJ, dancing, games and Navy Pier’s fireworks at dusk.

A shuttle will be available to take attendees back to the hotel at the conclusion of the cruise at 10:00pm.

Conference Banquet

The banquet will be hosted in Stanley Field Hall at the Field Museum, located at 1400 S. Lake Shore Drive, Chicago, IL 60605. In this grand entryway, conference attendees will be greeted by gleaming white marble interiors, sky lit vaulted ceilings, and stately columns—complete with fighting African Elephants, our stunning Haida Totem Poles, hanging gardens, and the titanosaur *Patagotitan mayorum*, fondly known as Maximo!

The banquet will include a buffet dinner, open bar dancing, touchable specimens, and the chance to view the museum exhibits, including the new exhibit hall for SUE, the *Tyrannosaurus rex*!

Doors will open at 6:30pm with dinner starting at 7:00pm. Please bring your ticket with you for check in.

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Field Trips

Field Trips will meet at the Registration Desk located at the 8th Street entrance on the Lobby floor of the Chicago Hilton. The Registration Desk will be open early so you can pick up your materials, including your badge and ticket for your trip. All trips will include lunch

Field Trip boarding times are as follows:

Saturday, May 25th Horicon Marsh

Boarding Begins at 6:30am

Bus Departs at 7:00am

Bus Return to Chicago Hilton at approximately 7:00pm

Special Trip Notes: Please dress for the weather and wear comfortable shoes for walking trails.

Sunday, May 26th

Surf and Turf - Mazon Creek and Silurian fossils

Boarding begins at 7:30am

Bus Departs at 8:00am

Bus will Return to Chicago Hilton at approximately 6:00pm

Special Trip Notes: Please bring along shoes you do not mind getting wet or muddy; depending on how adventurous you are, the fossils may be found along the river banks and in water that may be ankle deep to waist deep or more.

Milwaukee Public Museum

Boarding Begins at 8:00am

Bus Departs at 8:30am

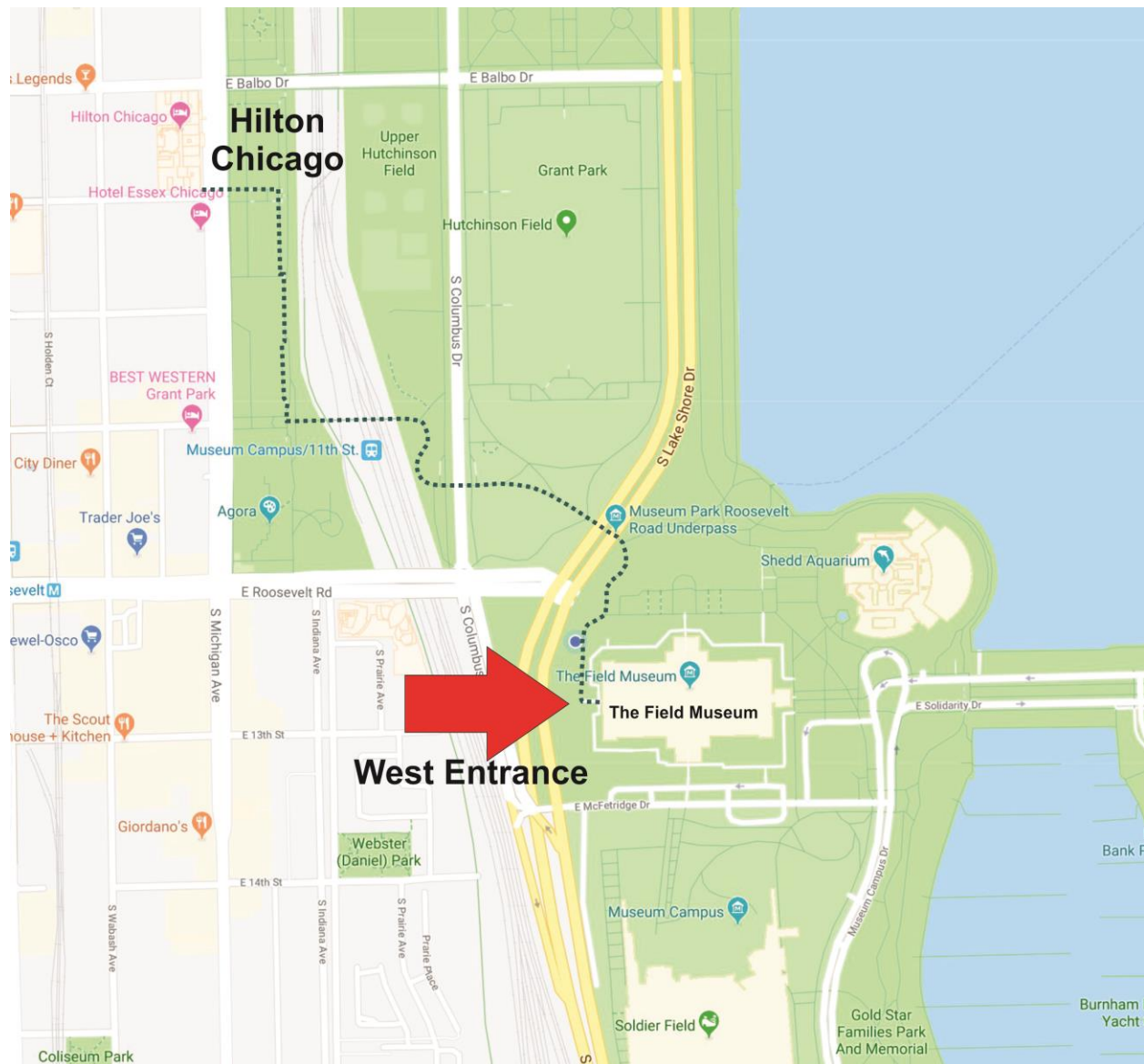
Bus Returns to Chicago Hilton at approximately 6:00pm

Workshops

The pre-conference workshops will take place on Monday, May 27th at the Field Museum 1400 S. Lake Shore Drive, Chicago, IL 60605.

Please refer to the schedule in this program for times and room assignments.

The Field Museum is a short 20-minute walk from the Hilton Chicago through Grant Park, just follow the paths and the bridge over the Metra tracks and tunnels under Columbus and Lake Shore drives. Check-in for all workshops will be at the West Door of the Field Museum, beginning at 8:00am. Please refer to the map below for the location of the Field Museum's West entrance.



Getting Around Chicago

Chicago is a walking city with an easy-to-navigate downtown grid. Madison Street divides the city north and south, while State Street divides it east and west. The State/Madison intersection marks the origin of Chicago's address grid system. Addresses are relative to the distance from that mark, with eight blocks to every mile. So an address of 3200 North Clark means that it is 32 blocks (4 miles) north of Madison.

Chicago Transit Authority

The Chicago Transit Authority (CTA) operates the nation's second largest public transportation system – serving the City of Chicago and 40 neighboring communities by rail and bus. Pay cash for single trip rides or purchase a reloadable Ventra Transit Card or Unlimited Ride Pass for added savings.

For full fare information, transit card retailers and maps, visit the Chicago Transit Authority website at transitchicago.com. Also look to their site for the latest updates to train schedules and routes that may affect your travel plans.

Full Fare with Cash (bus only)

Acceptable on buses using exact change only in dollar bills or coins; no transfers available. Single ride: \$2.50

Single Ride Disposable Ventra Ticket (bus and rail)

Ventra Tickets are good only for a limited time and cannot be loaded again once used up. Includes a full fare and two transfers (a \$2.50 value), plus a \$0.50 limited-use media fee.

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Single ride: \$3.00

1-Day Disposable Ventra Ticket (bus and rail)

Ventra Tickets are good only for a limited time and cannot be loaded again once the value is used up. Includes unlimited rides within 24 hours of activation.

Unlimited rides for 24 hours: \$10.00

Full Fare with Reloadable Ventra Card (bus and rail)

Transfers must occur within two hours of the first ride. Available online and at rail station vending machines.

First ride: \$2.25 (bus)

First ride: \$2.50 (rail)

First transfer: \$0.25

Second transfer: FREE

O'Hare Station Fare (rail)

A \$5 O'Hare rate applies to riders paying full fare from the O'Hare Blue Line Station.

First ride if starting at O'Hare: \$5.00

First transfer: \$0.25

Second transfer: FREE

Unlimited Ride Passes (bus and rail)

Activated on first use, passes allow unlimited rides for the specified time, offering the best travel value.

1-Day CTA Fun Pass: \$10.00

3-Day CTA Pass: \$20.00

Taxis

Taxis are plentiful and easy to hail downtown, at the airports and throughout many Chicago neighborhoods. You can also electronically hail (E-Hail) a taxicab through a mobile app. CHICABS offers safe and secure options for a Chicago taxicab ride. CHICABS approved apps ARRO and CURB also let passengers electronically pay (E-Pay) for the taxicab fare through the app.

Credit cards are accepted in all taxi cabs by city mandate. It is standard to tip the driver about 15-20% of the fare, plus \$1-2 per bag if the driver helps you with luggage. Please note that all fares and taxes are subject to change; visit the City of Chicago website for additional taxicab passenger information.

Sample taxi fare between downtown and O'Hare Airport is \$40-50, and between Midway Airport is \$30-35 (tip not included).

Fares

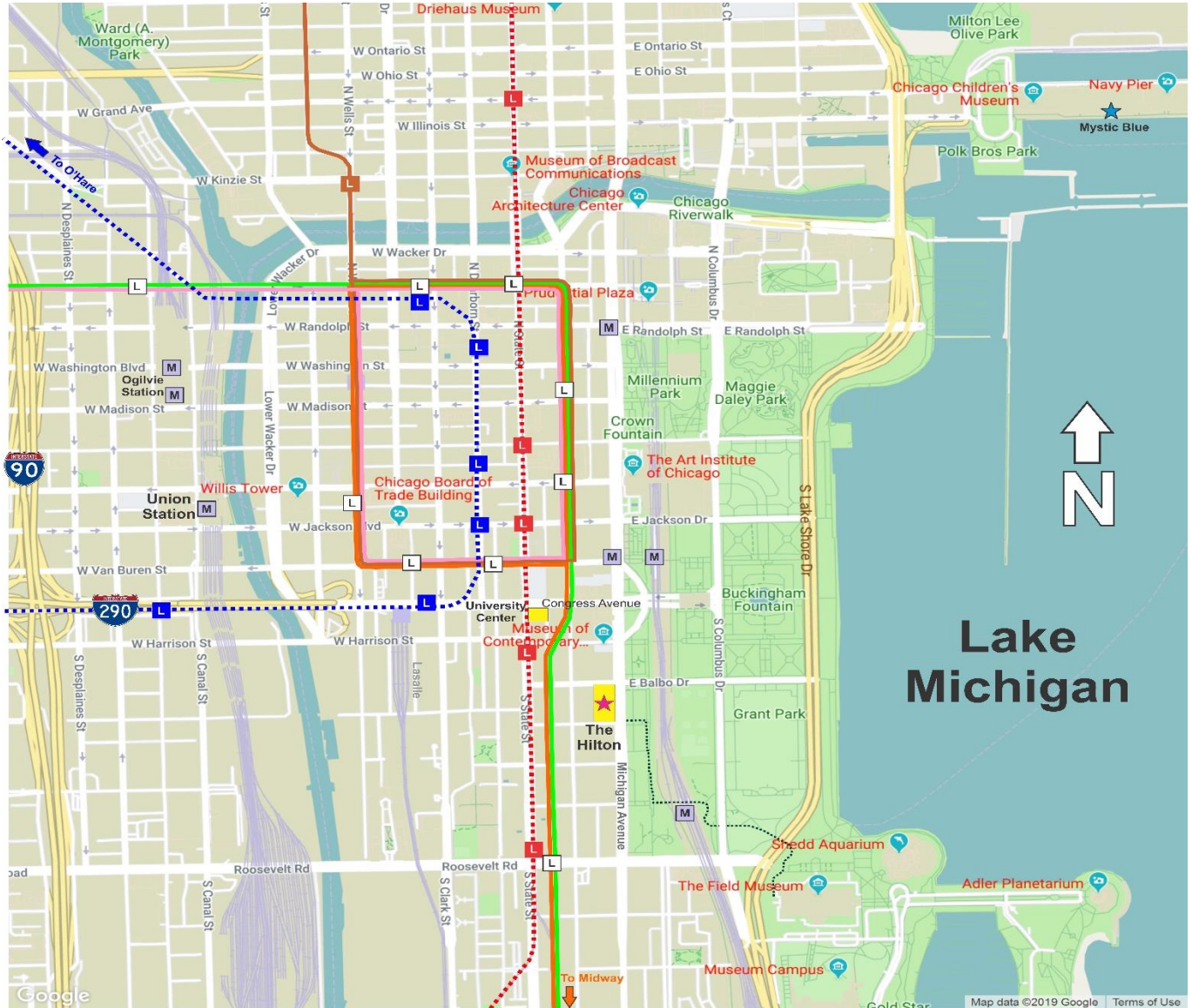
Taxis charge a base rate of \$3.25, plus \$2.25 for each additional mile and \$0.20 for every 36 seconds of time elapsed.

If a gas surcharge is in effect, a sign will be displayed inside the taxicab and a surcharge may apply. Tolls are an extra charge. Taxis charge \$1 for the first additional passenger over age 12 and under age 65; each additional passenger after that is \$0.50.



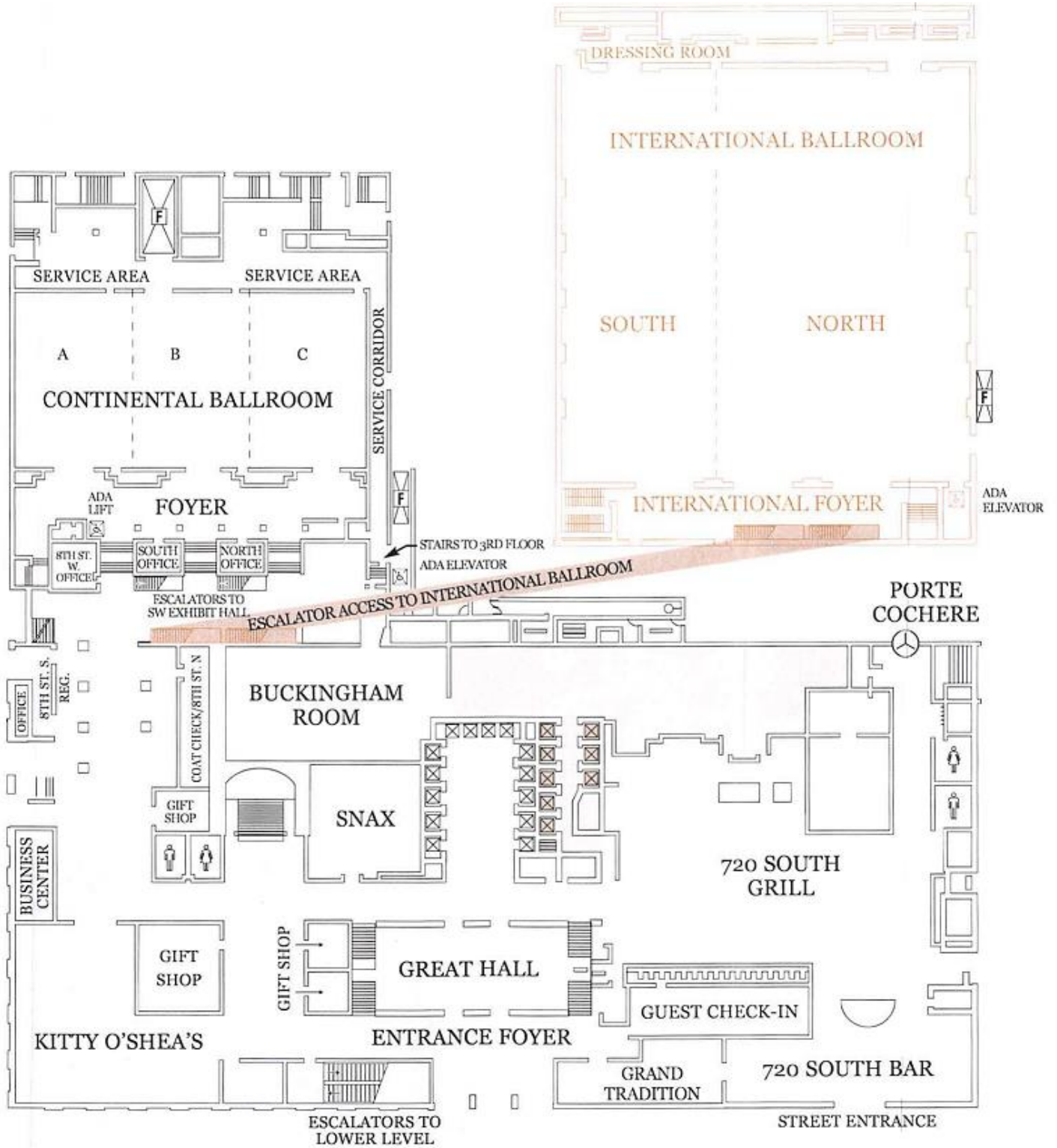
www.picturae.com

Map of Downton Chicago (The Loop)
 including Navy Pier, Mystic Blue boat dock, Union Station Ogilvie Station, Grant Park,
 University Center Housing, The Hilton, and Museum Campus (Field Museum, Adler
 Planetarium, and Shedd Aquarium)

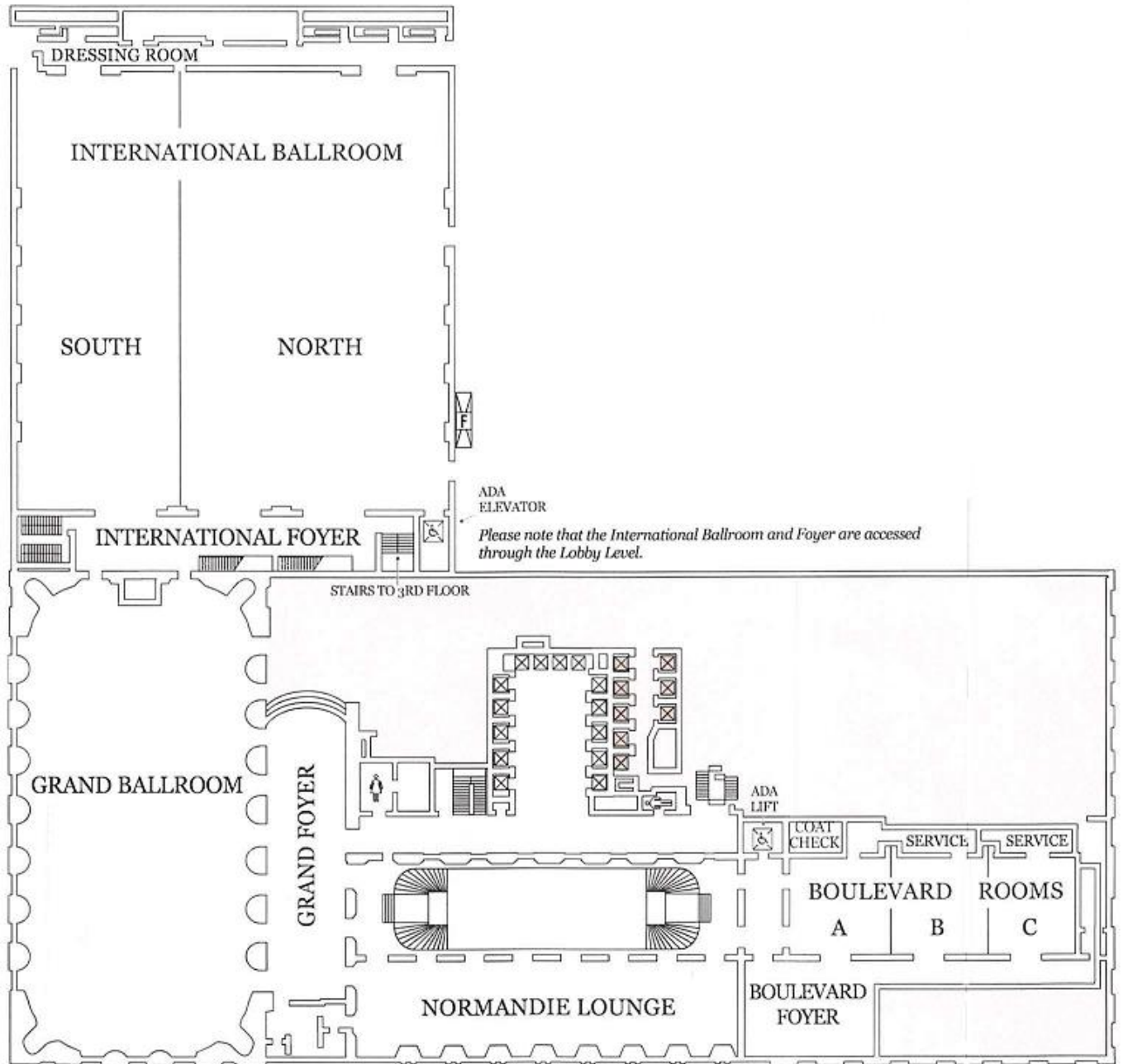


Train stations are represented by squares
 Metra and Amtrak tracks and stations are represented by squares with an 'M'.
 CTA 'L' trains (Blue, Red, Orange, Green, Pink and Brown lines) are represented by small squares with an 'L'.
 'L' stations serving multiple lines are white squares.
 Underground 'L' lines are dotted (Red and Blue lines).

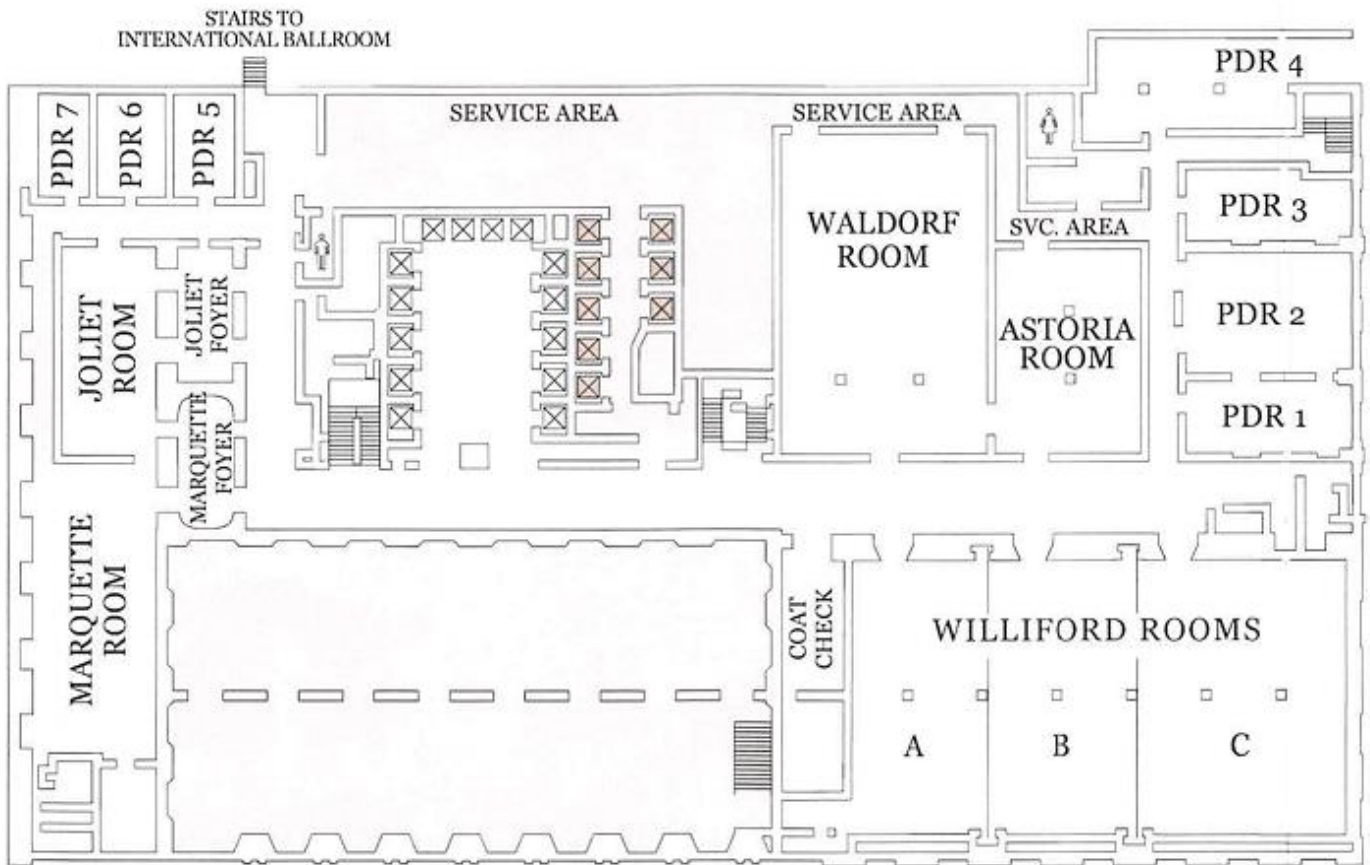
Chicago Hilton First Floor and Lobby



Chicago Hilton Second Floor



Chicago Hilton Third Floor



Schedule at a Glance

Saturday, May 25, 2019

Field Trip

Horicon Marsh
 Chicago Hilton - 8th Street Entrance
 Boarding begins at 6:30am
 7:00am - 7:00pm

Sunday, May 26, 2019

Field Trips

Surf and Turf
 Chicago Hilton - 8th Street Entrance
 Boarding begins at 7:30am
 8:00am - 6:00pm

Milwaukee Public Museum Collections and
 Museum Tour
 8th Street Entrance - Chicago Hilton
 Boarding begins at 7:30am
 8:00am - 6:00pm

Workshops

The Identification, Care, and Documentation
 of Mammal Ivory Objects
 Field Museum - West Entrance
 9:00am - 5:00pm

Applications of 3D Photogrammetry in
 Natural History Museums
 Field Museum - West Entrance
 9:00am - 5:00pm

Monday, May 27, 2019

Registration - SPNHC Registration Desk
 Chicago Hilton - 8th Street Entrance
 7:00 am to 6:00pm

Speaker Ready Room

Chicago Hilton - 8th Street Entrance
 3:00pm - 7:00pm

Workshops

Natural History Collections Club Network
 Workshop
 Field Museum - West Entrance
 8:00am - 5:00pm

Introduction to Natural Science Illustration
 Field Museum - West Entrance
 8:00am - 5:00pm

Caring for and Sharing Out Natural History
 Collections:
 Best Practices in Preparing Successful IMLS
 Grant Applications
 Field Museum - West Entrance
 8:30am - 1:00pm

Data Preparation and Standards to Get your
 Data Out There and Back Again
 Field Museum - West Entrance
 9:00am - 5:00pm

3D imaging using photogrammetry (cultural)
 Field Museum - West Entrance
 9:00am - 5:00pm

Please DO Touch: A collaborative approach to
 integrating collections specimens in authentic
 learning opportunities
 Peggy Notebaert Nature Museum
 2400 N. Cannon Drive
 10:00am - 1:00pm

Making the Case in Two Minutes -
 Elevator Pitches
 Field Museum - West Entrance
 1:30pm - 5:00pm

Social Events

Welcome Reception
 Normandie Room - Chicago Hilton
 6:00pm - 8:00pm

Tuesday, May 28, 2019

Registration - SPNHC Registration Desk
Chicago Hilton - 8th Street Entrance
7:00am - 9:00am then 2:00pm to 6:00pm
Registration will be closed during the Plenary
Session

Speaker Ready Room
Chicago Hilton - 8th Street Entrance
3:00pm - 7:00pm

Plenary Session and Lunch
Chicago Hilton - Second Floor
Grand Ballroom
9:00am - 1:30pm

Poster Session Set Up
Poster Session #1
Chicago Hilton - Third Floor
Astoria Room
2:00pm - 6:00pm

Sponsor Room Set Up
Williford Room
2:00pm - 6:00pm

SPNHC Committee Meetings
Chicago Hilton - Third Floor
PDR Rooms 1-4

2:00pm - 2:55pm
Long Range Planning Committee - PRD1
Web Committee - PRD2
Professional Development Committee - PDR3

SPNHC Committee Meetings
3:00pm - 3:55pm
Conservation Committee - PDR1
Publications Committee - PRD2
Legislation and Regulations Committee -
PDR3
Membership Committee - PDR4

4:00pm - 4:55pm
Best Practices Committee - PRD1

Emerging Professional Committee - PRD2
Conference Committee - PRD3
International Committee - PDR4

Social Events

Trivia Night
Revolution Brewery, 3340 N. Kedzie Ave,
Chicago, IL 60618
7:00pm - 10:00pm

Wednesday, May 29, 2019

Registration - SPNHC Registration Desk
8th Street Entrance - Chicago Hilton
7:00 am to 6:00pm

Speaker Ready Room
Chicago Hilton - 8th Street Entrance
8:00am - 5:30pm

Poster Session Set Up
Poster Session #1
Chicago Hilton - Third Floor
Astoria Room
7:00am - 8:00am

Poster Session #1
Chicago Hilton - Third Floor
Astoria Room
8:00am - 5:00pm

Sponsors Exhibit Room
Chicago Hilton - Third Floor
Williford Room
8:00am - 5:00pm

Symposium Presentations
Chicago Hilton - Lobby Level
Continental Ballroom A,B, C
8:00am - 5:00pm

Specimen Spotlight Presentations
Chicago Hilton - Third Floor
Waldorf Room
8:00am - Noon

Wednesday, May 29, cont.

Coffee Break

Chicago Hilton - Third Floor
Williford Room
9:45am - 10:00am

Lunch

Chicago Hilton - Third Floor
Williford Room
Noon - 1:30pm

Emerging Professional Luncheon

Chicago Hilton - Third Floor
Marquette Room
Noon - 1:30pm

Workshop

Importation of potentially infectious
specimens:
Striking a balance between safety and research
Chicago Hilton - Third Floor
Waldorf Room
1:30pm - 2:30pm

Coffee Break

Chicago Hilton - Third Floor
Williford Room
3:15 - 3:30pm

Workshops

Collections Assessment Methodology and
Impact On Management and Decision-
Making:
A Discussion on Uses and Lessons Learned.
Chicago Hilton - Third Floor
Waldorf Room
3:30pm - 4:30pm

Naturalis: collection management for the 21st
century
Chicago Hilton - Third Floor
Waldorf Room
4:30pm - 5:00pm

Poster Session Take Down

Poster Session #1

Chicago Hilton - Third Floor
Astoria Room
4:30pm - 5:00pm

Poster Session Set Up

Poster Session #2
Chicago Hilton - Third Floor
Astoria Room
5:00pm - 5:30pm

SPNHC Council Meeting

Chicago Hilton - 3rd Floor
Marquette Room
4:00pm - 5:30pm

Vendor Reception

Navy Pier - 600 E Grand Ave, Chicago, IL
60611
Mystic Blue Cruise
6:30pm - Boarding Begins
7:00pm - Ship Departs
10:00pm - return to Navy Pier

Thursday, May 30, 2019

Registration - SPNHC Registration Desk
8th Street Entrance - Chicago Hilton
7:00 am to 6:00pm

Specify Users Meeting

Chicago Hilton - 3rd Floor - PDR2
7:00am - 5:00pm

Speaker Ready Room

Chicago Hilton - 8th Street Entrance
8:00am - Noon

Poster Session #2

Chicago Hilton - Third Floor
Astoria Room
8:00am - 5:00pm

Sponsors Exhibit Room

Chicago Hilton - Third Floor
Williford Room
8:00am - 4:00pm

Thursday, May 30 Cont.

Symposium Presentations
Chicago Hilton - Lobby Level
Continental Ballroom A, B, C
8:00am - 5:00pm

Demo Camp
Chicago Hilton - Third Floor
Waldorf Room
8:00am - 10:00am

Coffee Break
Chicago Hilton - Third Floor
Williford Room
9:45am - 10:00am

Arctos Working Group Meeting
Chicago Hilton - Third Floor
Waldorf Room
10:00am - Noon

Lunch
Chicago Hilton - Third Floor
Williford Room
Noon - 1:30pm

Specimen Spotlight Presentations
Chicago Hilton - Third Floor
Waldorf Room
1:30pm - 5:00pm

Coffee Break
Chicago Hilton - Third Floor
Williford Room
3:15 - 3:30pm

Poster Session Take Down
Poster Session #2
Chicago Hilton - Third Floor
Astoria Room
4:30pm - 5:00pm

Conference Banquet
Field Museum
6:30pm - 11:00pm

Friday, May 31, 2019

All events will take place at the Field
Museum

SPNHC Educational Materials Share Fair
Field Museum - Classroom B
8:30am - 11:00am

Special Interest Groups
Avoiding Carcinogen Exposure
Field Museum - Ground Floor
Classroom A
9:30am - 10:30am

Science Through Story: Engaging Broad
Audiences
Field Museum - Ground Floor
Classroom B
9:30am - 11:00am

Panel Discussion
Field Museum - Ground Floor
Simpson Theater
10:00am - 11:00am

Coffee Break
11:00 - 11:15am
Field Museum - Ground Floor

Annual Business Meeting
Simpson Theater
11:30am - 1:00pm

Lunch
Field Museum - Ground Floor
West Lobby - Outside of Simpson Theater
1:00pm - 2:30pm

Field Museum Collections Tours
Field Museum Various location meeting points
1:30pm - 5:00pm

Quick Schedule 2019 Chicago SPNHC Meeting							
May 25 Saturday	May 26 Sunday	May 27 Monday	May 28 Tuesday	May 29 Wednesday	May 30 Thursday	May 31 Friday	
Field Trip: Horicon Marsh	Field Trips:	FMNH	Hilton	Hilton	Hilton	FMNH	
	Geology Surf and Turf	Workshops: Specimens Enrich Learning	Morning Plenary Session	Morning General Session	Morning General Session	Education Share Fair SIGs Annual Business Meeting	
	MPM Tour	Scientific Illustration	Lunch	Lunch	Lunch	Lunch	
	Workshops: Ivory	3D Imaging IMLS Grants	SPNHC Committee Meetings	PM General Session	PM General Session	FMNH Collections Tours	
	3D Imaging II	Idea Pitch Data Prep Standards		Council Meeting			
		Natural History Collection Club					
		“Please Do Touch” at Peggy Notebaert Museum					
			Hilton	Revolution Brewing	Navy Pier	FMNH	Vice Brewery
		Ice Breaker		Trivia Night	Lake Cruise Vendor Reception	SPNHC Banquet	Informal Farewell

Wednesday May 29 - Continental Ballroom A			
Time	Symp	Title	Presenter
8:00	SY-02	Decoding Legalese: Intro to Copyright, Licenses, and Other Intellectual Property Issues for Non-Lawyers	Sarah Ebel
8:15	SY-02	Data Licenses, Waivers, and Publication: the Creative Commons and How to Share Your Data for the Greatest Good	David Bloom
8:30	SY-02	The GDPR-Compliance Waltz: Balancing Necessity, Legitimate Interests and Data-Subject Rights in the GBIF Network	Kyle Aaron Copas
8:45	SY-02	Discussion	
9:00	SY-03	How Did This Get Here?	Alyssa Caywood
9:15	SY-03	The Symbiota Sequence Submission Tool	Andrew N. Miller
9:30	SY-03	To Connect is to Preserve: On Frugal Data Integration and Preservation Solutions	Jorrit H. Poelen
9:45	Coffee Break		
10:00			
10:15	SY-03	Giving Credit Where Credit's Due: Demonstrating the Value of Sharing FAIR and Open Biodiversity Data by Linking DOI-Based Research Citations to Publishers and Datasets	Kyle Aaron Copas
10:30	SY-03	Living Atlases: Using ALA as Thematic or National Data Portal	Marie-Elise Lecoq
10:45	SY-03	Networks of Species, Data and People	Robert P. Guralnick
11:00	SY-03	CSIRO's Collection Manage Service: a Collections Data Ecosystem Approach to Better Connecting Disparate yet Related Data	Simon Checksfeld
11:15	SY-03	The Arctos Ecosystem: Using Standardized, Predictable Data to Form Resolvable, Reciprocal Links to Related Internal and External Data Objects	Teresa J. Mayfield-Meyer
11:30	SY-03	A Plant Said to Make Lions and Tigers Docile*	Yvette B. Harvey
11:45	SY-03	Discussion	
Noon	Lunch		
12:15			
12:30			
12:45			
1:00			
1:15			
1:30	SY-06	Welcome	
1:45	SY-06	Measuring Impact by Empowering Users to Illustrate the Effort They Put in Natural History Collections	David P. Shorthouse
2:00	SY-06	A Proposed Metadata Standard for Recording and Sharing Attribution Information	Anne E. Thessen
2:15	SY-06	Success Metrics in Arctos (and What We Hope to Build)	Teresa J. Mayfield-Meyer
2:30	SY-06	Determining What Counts in Academia – Insights from a Small University Museum	Carrie A. Eaton
2:45	SY-06	Dashboard Confessionals: Obstacles and Challenges to Measuring the Success of a National Scale Digitization Program	Deborah L. Paul
3:00	SY-06	Tweaking the System: Using e-Journal Technology and Existing Citation Tools to Increase the Visibility and Measurable Impact of Museums, Curation and Specimen-Based Data	Christopher J. Marshall
3:15	Coffee Break		
3:30	SY-06	Measuring Success for Collections: Educational Products and Outcomes	Anna K. Monfils
3:45	SY-06	From Scraps to Cache: A Case for Structured Education Collections	Kimberly J. Cook
4:00	SY-06	International Discussion and Panel	
4:15			

Wednesday May 29 - Continental Ballroom B			
Time	Symp	Title	Presenter
8:00	SY-10	Materials Selection & Specification Working Group: a New Initiative of the AIC Collection Care Network	Rachael Arenstein
8:15	SY-10	Resources Display Unit: Past, Present and Future	Rebecca E. Newberry
8:30	SY-10	Byne Disease: From a Conservation Report to the Formulation of New Needs of Research	Véronique Rouchon
8:45	SY-10	STASHc.com, a Platform for Collaboration: Website Tour	Lisa Goldberg
9:00	SY-10	Discussion	
9:15	SY-10	Long Oversized Automatic Shelving	Carolyn G. Levitt-Bussian
9:20	SY-10	Lightweight, Rigid Support Cradles for Fragile but Heavy Specimens, Made from an Epoxy Clay Compound	Linsly J. Church
9:25	SY-10	Shelf Liners for Fluid Collections	Gretchen E. Anderson
9:30	SY-10	Clean, Bright and Waterproof: Custom Tyvek® Covers	Deborah G. Harding
9:35	SY-10	Ring Mounts on Boards	Rebecca E. Newberry
9:40	SY-10	Using Neodymium Magnets to Hang Horizontal Mounts in Steel Cabinets	Cindy E. Opitz
9:45	Coffee Break		
10:00			
10:15	SY-10	Efficient and Novice-Proof Physical Tracking of Cultural and Biological Collections Using Machine Readable Barcodes	Kyndall B. P. Hildebrandt
10:20	SY-10	Preservation Housing of Multi-Part Bird Specimen for Educational Use	Dawn R. Roberts
10:25	SY-10	Discussion	
10:30	SY-10		
10:45	GS-01	Utilizing the Salting out Method to Distinguish between Common Fluid Preservatives	Irene Finkelde
11:00	GS-01	Preservation of Wet Collections: Non-Invasive Fluid and Containers Identification Using Micro-Raman Spectroscopy	Sophie Cersoy
11:15	GS-01	Larger Specimens: Addressing the Need for Wide-Mouth Jars in Collections	William G. Keel
11:30	GS-01	Preservation of Animal Genetic Resources: Current Practices and Future Opportunities	Breda M. Zimkus
11:45	GS-01	Do Storage Temperatures Affect DNA Quality of Samples in Genetic Resource Collections?	Taylor J. Soniat
12:00	Lunch		
12:15			
12:30			
12:45			
1:00			
1:15			
1:30	GS-01	Export Compliance Issues in Natural History Collections	Amanda Robinson
1:45	SY-11	The National Meteorite Collection – From Allende to Zagami -	Julie Hoskin
2:00	SY-11	Just Smash It! Sampling Techniques of Meteorites for Destructive Analysis	James L. Holstein
2:15	SY-14	Best Practices for Destructive Sampling in Vertebrate Palaeontology	Thomas M. Cullen
2:30	SY-14	Don't touch the Pretty Ones: Destructive Sampling Protocols in the Canadian Museum of Nature's Mineral Collection	Erika B. Anderson
2:45	SY-14	Reading the Layers - Destructive Sampling of Marine Mammal Specimens at the California Academy of Sciences.	Maureen (Moe) Flannery
3:00	SY-14	Non-Destructive Destructive Sampling: The Uses and Limitations of Computed Tomography (CT) for Traditionally Destructive Investigations	Stephanie M. Smith
3:15	Coffee Break		
3:30	GS-01	Unlocking the Potential in Backlogs: A Case Study of Holistic Sampling on Frozen Backlog Specimens	Amanda N. Lawrence
3:45	GS-01	Using the Swat Team Concept to Address Collections Backlogs	William F. Simpson
4:00	GS-01	Processing Historic Backlog: Lessons Learned	Mare Nazaire

Wednesday May 29 - Continental Ballroom C			
Time	Symp	Title	Presenter
8:00	GS-01	The Berlin Skin Collection is Under Observation – Testing Handheld XRF and Other Cost-Efficient Methods for Profiling a Large Collection	Steffen Bock
8:15	GS-01	How do I Choose? Assessment of Fossil Preparation Techniques by Scanning Electron Microscopy	Mariana Di Giacomo
8:30	GS-01	Beyond the Visible Spectrum: The Use and Application of Ultraviolet (UV) Light Photography as a Diagnostic Tool for Discovery, Digital Documentation and Analysis of Paleontological Specimens	Rene L. Lauer
8:45	GS-01	Cracking it Open: Addressing Mineral Instability within Museum Environments	Kathryn Royce
9:00	GS-01	Understanding the Mechanisms of Pyrite Decay	Lisa L. Herzog
9:15	GS-01	Reuniting the Canadian National Mineral Collection: Collection #1 - Moving Radioactive Minerals	Michelle H. Coyne
9:30	GS-01	Hunting Fossils Online to Donate to Museums and Discover New Species	Mary K. Pankowski
9:45 10:00	Coffee Break		
10:15	GS-01	Other Funders to Consider: Funding Other than Federal!	Zoe Magierek
10:30	GS-01	Rescuing Endangered Collections	Catherine Leard
10:45	GS-01	Envisioning Yale's New Home for Natural History: the Yale Peabody Museum	Russell D. White
11:00	GS-01	Rethinking Climate Control Strategies in Yale Peabody Museum Collections	Susan H. Butts
11:15	GS-01	Time and Light: the Long Process of Daylighting an Iconic Paleontology Gallery	Angela N. Matchica
11:30	GS-01	Everything Old is New Again: Dilemmas, Contradictions and Differing Practices in the Redevelopment of Natural History Exhibitions.	Alison P. Douglas
11:45	GS-01	We're Hosed: Managing Risk during Early Planning	Casey A. Gallagher
Noon to 1:15pm Lunch			
1:30	GS-01	The Mission for the Next Generation: New Permanent Exhibitions for Natural History Collections in National Museum, Prague, Czech Republic	Ivo Macek
1:45	GS-01	Making Hay While the Sun Shines at the University of Puerto Rico Museum of Zoology	Janelle A. Peña Jimenez
2:00	GS-01	Research, Curatorial and Outreach Opportunities at the Mammals' Collection, Instituto Alexander von Humboldt, Colombia (IAvH-M)	Andrés J. Lozano-Flórez
2:15	GS-01	CSIRO's National Biological Collections as 21st Century Research Infrastructure	Andrew G. Young
2:30	GS-01	The Value of the Invaluable: The Challenge of Making a Scientific Collection Visible Through its Economic Estimation	M. Alejandra Camacho
2:45	GS-01	Rabor Wildlife Collection: Today's Record for Understanding Remarkable Biodiversity of the Philippine Islands	Juan Carlos T. Gonzalez
3:00	GS-01	The Zoological Collections at the Instituto De Biología, Universidad Nacional Autónoma De México (IB UNAM)	Alejandro Zaldivar-Riverón
3:15	Coffee Break		
3:30	GS-01	Collections Make Connections at the Iziko South African Museum	Zaituna Skosan
3:45	GS-01	From Butterflies to Ichthyosaurs the Importance of the Nevada State Museum, Las Vegas Natural History Collections	Sali A. Underwood
4:00	GS-01	The Largest Terrestrial Arthropod Collection in the Philippines: History, Status and Prospect	Jeremy Carlo B. Naredo
4:15	GS-01	The Australian National Insect Collection: An Ever-Growing International Hub for Entomological Science	Federica Turco
4:30	GS-01	The Status of the Philippine National Museum's Entomological Collections and the Management's shift towards Better Collections Management	Perry Archival C. Buenavente

Wednesday May 29 - Waldorf Room			
Time	Symp	Title	Presenter
8:00	SS-01	Welcome	
8:15	SS-01	The Tully Monster: What Can We Learn from a Strange 300 Million Year Old Fossil?	Paul Mayer
8:20	SS-01	He Mapped the Ancient Seas and Fathomed the Geologic Past	Russell D. White
8:25	SS-01	A Cambrian Can of Worms: Fossil Preservation and Best Practices in Collections	Anna F. Whitaker
8:30	SS-01	Beecher's Trilobite Bed	Jessica Utrup
8:35	SS-01	Giants of the Ordovician Seas	Patricia Coorough Burke
8:40	SS-01	The Discovery of Darwin's Sand Dollar	Jessica D. Cundiff
8:45	SS-01	The Boaz and Anderson Mills Mastodon(s)	Carrie A. Eaton
8:50	SS-01	Squee! Ahhh! What, no!? And Other Reactions to a Fuzzy Rock	Jess Miller-Camp
8:55	SS-01	The Murchison Meteorite: 50 Years of Discovery	James L. Holstein
9:00	Mini Break 5 minutes		
9:05	SS-01	The Marvelous Mystery of Micromounts	Cailin E. Meyer
9:10	SS-01	More Than Just a Pretty Picture: Paleoart as a Tool to Teach Evolution	Adrienne M. Stroup
9:15	SS-01	Two Botanists and An Artist Walk Into the Desert...	Tiana F. Rehman
9:20	SS-01	Confounding Collections: The Payne of Stewardship	Kimberly J. Cook
9:25	SS-01	Québec's Only <i>Gentainella quinquefolia</i>	Nadia Cavallin
9:30	SS-01	Revitalizing Heirloom Maize Through Whisky	Taryn Pelch
9:35	SS-01	The Mummy's Lichen at the Farlow Herbarium	Michaela Schnull
9:40	SS-01	<i>Camellia x williamsii</i> 'St. Ewe'	Mandeep Matharu
9:45 to 10:00	Coffee Break 30 minutes		
10:15	SS-01	Steinbeck/Ricketts Starfish	Chrissy Piotrowski
10:20	SS-01	The Vampire Squid from Hell	Christine Zorn
10:25	SS-01	The Precious and Beautiful Gynandromorph	Laurel Kaminsky
10:30	SS-01	Lord Howe Stick Insect: Back from Extinction?	Debbie Jennings
10:35	SS-01	Saving Slimy Salamanders: Using Modern Techniques on Legacy Collections	Amanda N. Lawrence
10:40	SS-01	Chameleon Specimen	Helen Kairo
10:45	SS-01	The Narborough Island Tortoise	Lauren Scheinberg
10:50	SS-01	The Dying Robins of Michigan State University	Laura M. Abraczinskas
10:55	SS-01	Thick-billed Parrot (<i>Rhynchopsitta pachyrhyncha</i>)	Serina Brady
11:00	Mini Break 5 minutes		
11:05	SS-01	A Tale of a Whale	Aren M. Gunderson
11:10	SS-01	Sea Otter and Abalone	Ann M. Bishop
11:15	SS-01	Tenacious - The Resilient Nature of the Black-Footed Ferret (<i>Mustela nigripes</i>)	Corey A. Anco
11:20	SS-01	How much Research Could a Bat Bug Bolster, if a Bat Bug Could Bolster Research?	Benjamin Spitz
11:25	SS-01	The Arctos Specimen Standard	Aren Gunderson
11:30	SS-01	Orca O319 - The Journey from the Beach to the Exhibit Hall	Maureen (Moe) Flannery
11:35	SS-01	Man's Best Friend: A 7000 Year Old Dog Burial in the Great Basin	Rachel K. Delovio
11:40	SS-01	Zinacantec Tunic	Lori Benson
11:45	SS-01	Rediscovering Iris the Ichthyosaur: The <i>Shonisaurus popularis</i> Type Specimen at the Nevada State Museum, Las Vegas	Sali A. Underwood
11:50	SS-01	American Purple Gallinule: An Unlikely Representative of Northwoods Biodiversity	Mollie Krebs
11:55			
Noon to 1:15pm Lunch			
CDC Symposium			
1:30	CDC	Importation of potentially infectious specimens: Striking a balance between safety and research	Adam Ferguson
1:45	CDC	Overview of CDC Import Permit Program	Glen Degruy
2:00	CDC	Importation Requirements for Bats and Non-Human Primates	Meredith Pyle
2:15	CDC	Inspection of Facilities Importing Potentially Infectious Agents	Thomas Cremer
2:30	CDC	Implementation of the New eIPP Online Permit Application System	Thomas Cremer & Meredith Pyle
2:45	CDC	Best Practices for Transporting Hazardous Materials	Neal Suchak
3:00	CDC	Importing Potentially Infectious Materials for Natural History Museums: A (Mammal) Collection Manager Perspective	Adam Ferguson
		Move to PDR Room 2 for discussion/round table	
3:15	Coffee Break 15 minutes		

Wednesday May 29 - Waldorf Room Cont.			
3:30	SY-09	Collections Assessment Methodology and Impact on Management and Decision-Making: A Discussion on Uses and Lessons Learned.	Carol R. Butler
3:45			
4:00			
4:15			
4:30	SY-09	Naturalis: Collection Management for the 21st Century	Christel Schollaardt
4:45	SY-09	Discussion	

Posters Wednesday May 29th - Astoria Room

#	Title	Presenter
1	Rebuilding the Relationship between Science and Illustration through SFA (Science Finds Art)	Elissa S. Martin
2	Examining Critical Thinking Skills of Middle-School Age Learners with 3D Models of Museum Objects in an Inquiry-Based Learning System	Carolyn G. Levitt-Bussian
3	Partnering with the Beaty Biodiversity Museum to Enhance Learning Experiences for First-Year Students in the University of British Columbia's Biology Program	Linda Jennings
4	Fossil Digitization Internships of Ordovician/Silurian Collections of the Field Museum and Milwaukee Public Museum.	Monica A. Rasch
5	Digitizing the Konecny Collection: Bringing a Local Fossil Collection to a Worldwide Audience	Tim Diamond
6	Internship Cataloguing Utah Dinosaurs	Cathy Wiegand
7	Cataloging the Antarctic Fish Collection of Joseph Eastman	Oliver D. Orr
8	Depicting Extinction and Evolution	Cai L. Czuhai
9	Trapping High School Students with Fossils: Utilizing Science Outreach to Curate Natural Trap Cave Fossils and Inspire the Pursuit of STEM Careers.	Cory M. Redman
10	Inclusion of Fieldwork and the Curatorial Process into a STREAM Girls Summer Camp	Katie Peterson
11	Q?rius about Engaging Students in the Herbarium: An After School Botany Program	Erika M. Gardner
12	Northern Museum of Zoology: Reinvigorating a Resource for Enriching Undergraduate Education	Madeline Arszulowicz
13	Building a Student and Volunteer Network for Notes from Nature Herbarium Transcription Success in Arkansas	Diana L. Soteropoulos
14	Flexing Mussels: Developing a Crowd-Sourced Workflow to Explore Morphological Variations in Freshwater Mussels Using the Milwaukee Public Museum Collections	Keely A. Gobat
15	Green Pioneers, a Citizen Science Project at Meisei Botanic Garden	Sofie De Smedt
16	Specimen Digitization at the Canadian National Collection of Insects, Arachnids & Nematodes (CNC)	Owen Lonsdale
17	Project Macroinvert: Bringing Aquatic Macroinvertebrate Collections Out of the Dark at Arkansas State University	Hilary K. Canada
18	Entomology Backlog Flats Digitization Project - California Academy of Sciences	Alice E. Fornari
19	Changes in Lepidoptera Collecting in the United States Since 1800	Anthony I. Cognato
20	Digitization - The Backbone of Our Strategy to Increase Accessibility to Vertebrate Collections	Stephanie Tessier
21	Capturing the Perfect Digital Specimen – An Overview of Vertebrate Imaging Techniques	Marie-Helene Hubert
22	How to See the Story: Visualizing Specimen Data to Read the Scope and Status of a Collection of Mesa Verde Vertebrates	Jessica J. Mailhot
23	A New Approach to Digitizing and Imaging the Harvard University Herbaria Wood Slides	Madelynn von Baeyer
24	Improved Specimen Preservation through Digitization at Canada's National Collection of Vascular Plants	Shannon Asencio
25	Data Collection and Conservation at Two Late Triassic Bone Beds	Hannah R. Miller
26	BHL and Specimen Collection Data: The Needle in the Festuca Stack	Martin R. Kalfatovic
27	Arctos: A Collaborative Collection Management Solution	Emily M. Braker
28	Mind the Gap – A Workflow for Maintaining Data Connectivity Across Museum Collections	Serina Brady
29	Championing Overlooked Information: The Importance of Collecting Routine Data Relating to the Preparation or Analysis of Natural History Specimens.	Nyssa D. Mildwaters
30	Making a Large Impact on a Small Herbarium: The Impacts of an NSF CSBR Grant on a Regional Herbarium	Andrea Appleton
31	Libraries of Life: Connecting Audiences with Natural History Collections Via Augmented Reality	Anne Basham
32	Taxonomic Classification of <i>Diplazium molokaiense</i> , a Fern Endemic to Hawaii, Using Molecular and Morphological Characters	P. Roxanne Kellar
33	Extra-terrestrial conservation: storing the Cranbourne Meteorites	Danielle Measday

Wednesday May 29th SPNHC Presentations by time				
Time	R m	Symp	Title	Presenter
7:45	A	SY-02	Welcome to Symposium SY-02 Licensing And Rights Around Collections Data And Media	
	B	SY-10	Welcome to Symposium SY-10 Storage Techniques For Art, Science, And History Collections (STASH) Preventive Conservation And Storage: STASH Flash Ilto Symposium	
	C	GS-01	Welcome To General Session Talks Day One	
	W			
8:00	A	SY-02	Decoding Legalese: Intro to Copyright, Licenses, and Other Intellectual Property Issues for Non-Lawyers	Sarah Ebel
	B	SY-10	Materials Selection & Specification Working Group: A New Initiative of the AIC Collection Care Network	Rachael Arenstein
	C	GS-01	The Berlin Skin Collection is Under Observation – Testing Handheld XRF and Other Cost-Efficient Methods for Profiling a Large Collection	Steffen Bock
	W	SS-01	Welcome to Specimen Spotlight	
8:15	A	SY-02	Data Licenses, Waivers, and Publication: The Creative Commons and How to Share Your Data for the Greatest Good	David Bloom
	B	SY-10	Resources Display Unit: Past, Present and Future	Rebecca E. Newberry
	C	GS-01	How do I Choose? Assessment of Fossil Preparation Techniques by Scanning Electron Microscopy	Mariana Di Giacomo
	W	SS-01	The Tully Monster: What Can We Learn from a Strange 300 Million Year Old Fossil?	Paul Mayer
	W	SS-01	He Mapped the Ancient Seas and Fathomed the Geologic Past	Russell D. White
	W	SS-01	A Cambrian Can of Worms: Fossil Preservation and Best Practices in Collections	Anna F. Whitaker
8:30	A	SY-02	The GDPR-Compliance Waltz: Balancing Necessity, Legitimate Interests and Data-Subject Rights in the GBIF Network	Kyle Aaron Copas
	B	SY-10	Byne Disease : From a Conservation Report to the Formulation of New Needs of Research	Véronique Rouchon
	C	GS-01	Beyond the Visible Spectrum: The Use and Application of Ultraviolet (UV) Light Photography as a Diagnostic Tool for Discovery, Digital Documentation and Analysis of Paleontological Specimens	Rene' L. Lauer
	W	SS-01	Beecher's Trilobite Bed	Jessica Utrup
	W	SS-01	Giants of the Ordovician Seas	Patricia Coorough Burke
	W	SS-01	The Discovery of Darwin's Sand Dollar	Jessica D. Cundiff
8:45	A	SY-02	Discussion	
	B	SY-10	STASHc.com, A Platform for Collaboration: Website Tour	Lisa Goldberg
	C	GS-01	Cracking it Open: Addressing Mineral Instability within Museum Environments	Kathryn Royce
	W	SS-01	The Boaz and Anderson Mills Mastodon(s)	Carrie A. Eaton
	W	SS-01	Squee! Ahhh! What, no!? And Other Reactions to a Fuzzy Rock	Jess Miller-Camp
	W	SS-01	The Murchison Meteorite: 50 Years of Discovery	James L. Holstein
9:00	A	SY-03	How Did This Get Here?	Alyssa Caywood
	B	SY-10	Discussion	
	C	GS-01	Understanding the Mechanisms of Pyrite Decay	Lisa L. Herzog
	W	SS-01	Mini break	
	W	SS-01	The Marvelous Mystery of Micromounts	Cailin E. Meyer
	W	SS-01	Québec's Only <i>Gentainella quinquefolia</i>	Nadia Cavallin
9:15	A	SY-03	The Symbiota Sequence Submission Tool	Andrew N. Miller
	B	SY-10	Long Oversized Automatic Shelving	Carolyn G. Levitt-Bussian
	B	SY-10	Lightweight, Rigid Support Cradles for Fragile but Heavy Specimens, Made from an Epoxy Clay Compound	Linsly J. Church
	B	SY-10	Shelf Liners for Fluid Collections	Gretchen E. Anderson
	C	GS-01	Reuniting the Canadian National Mineral Collection: Collection #1 - Moving Radioactive Minerals	Michelle H. Coyne
	W	SS-01	More Than Just a Pretty Picture: Paleoart as a Tool to Teach Evolution	Adrienne M. Stroup
	W	SS-01	Two Botanists and An Artist Walk Into the Desert...	Tiana F. Rehman
	W	SS-01	Confounding Collections: The Payne of Stewardship	Kimberly J. Cook
9:30	A	SY-03	To Connect is to Preserve: On Frugal Data Integration and Preservation Solutions	Jorrit H. Poelen
	B	SY-10	Clean, Bright and Waterproof: Custom Tyvek® Covers	Deborah G. Harding
	B	SY-10	Ring Mounts on Boards	Rebecca E. Newberry
	B	SY-10	Using Neodymium Magnets to Hang Horizontal Mounts in Steel Cabinets	Cindy E. Opitz

	C	GS-01	Hunting Fossils Online to Donate to Museums and Discover New Species	Mary K. Pankowski
	W	SS-01	Revitalizing Heirloom Maize Through Whisky	Taryn Pelch
	W	SS-01	The Mummy's Lichen at the Farlow Herbarium	Michaela Schnull
	W	SS-01	<i>Camellia x williamsii</i> 'St. Ewe'	Mandeep Matharu
9:45 to 10:15	A		Coffee Break	
	B			
	C			
	W			
10:15	A	SY-03	Giving Credit Where Credit's Due: Demonstrating the Value of Sharing FAIR and Open Biodiversity Data by Linking DOI-based Research Citations to Publishers and Datasets	Kyle Aaron Copas
	B	SY-10	Efficient and Novice-Proof Physical Tracking of Cultural and Biological Collections Using Machine Readable Barcodes	Kyndall B. P. Hildebrandt
	B	SY-10	Preservation Housing of Multi-Part Bird Specimen for Educational Use	Dawn R. Roberts
	B	SY-10	Discussion	
	C	GS-01	Other Funders to Consider: Funding Other than Federal!	Zoe Magierek
	W	SS-01	Steinbeck/Ricketts Starfish	Chrissy Piotrowski
	W	SS-01	The Vampire Squid From Hell	Christine Zorn
	W	SS-01	The Precious and Beautiful Gynandromorph	Laurel Kaminsky
10:30	A	SY-03	Living Atlases: Using ALA as Thematic or National Data Portal	Marie-Elise Lecoq
	B	SY-10	Discussion	
	C	GS-01	Rescuing Endangered Collections	Catherine Leard
	W	SS-01	Lord Howe Stick Insect: Back from Extinction?	Debbie Jennings
	W	SS-01	Saving Slimy Salamanders: Using Modern Techniques on Legacy Collections	Amanda N. Lawrence
	W	SS-01	Chameleon Specimen	Helen Kairo
10:45	A	SY-03	Networks of Species, Data and People	Robert P. Guralnick
	B	GS-01	Utilizing the Salting out Method to Distinguish Between Common Fluid Preservatives	Irene Finkelde
	C	GS-01	Envisioning Yale's New Home for Natural History: the Yale Peabody Museum	Russell D. White
	W	SS-01	The Narborough Island Tortoise	Lauren Scheinberg
	W	SS-01	The Dying Robins of Michigan State University	Laura M. Abraczinskas
	W	SS-01	Thick-billed Parrot (<i>Rhynchopsitta pachyrhyncha</i>)	Serina Brady
11:00	A	SY-03	CSIRO's Collection Manage Service: A collections Data Ecosystem Approach to Better Connecting Disparate yet Related Data	Simon Checksfield
	B	GS-01	Preservation of Wet Collections: Non-Invasive Fluid and Containers Identification Using Micro-Raman Spectroscopy	Sophie Cersoy
	C	GS-01	Rethinking Climate Control Strategies in Yale Peabody Museum Collections	Susan H. Butts
	W	SS-01	Mini Break	
	W	SS-01	A Tale of a Whale	Aren M. Gunderson
	W	SS-01	Sea Otter and Abalone	Ann M. Bishop
11:15	A	SY-03	The Arctos Ecosystem: Using Standardized, Predictable Data to Form Resolvable, Reciprocal Links to Related Internal and External Data Objects	Teresa J. Mayfield-Meyer
	B	GS-01	Larger Specimens: Addressing the Need for Wide-Mouth Jars in Collections	William G. Keel
	C	GS-01	Time and Light: the Long Process of Daylighting an Iconic Paleontology Gallery	Angela N. Matchica
	W	SS-01	Tenacious - The Resilient Nature of the Black-Footed Ferret (<i>Mustela nigripes</i>)	Corey A. Anco
	W	SS-01	How much Research Could a Bat Bug Bolster, if a Bat Bug Could Bolster Research?	Benjamin Spitz
	W	SS-01	The Arctos Specimen Standard	Aren Gunderson
11:30	A	SY-03	A plant Said to Make Lions and Tigers Docile*	Yvette B. Harvey
	B	GS-01	Preservation of Animal Genetic Resources: Current Practices and Future Opportunities	Breda M. Zimkus
	C	GS-01	Everything Old Is New Again: Dilemmas, Contradictions and Differing Practices in the Redevelopment of Natural History Exhibitions.	Alison P. Douglas
	W	SS-01	Orca O319 - The Journey from the Beach to the Exhibit Hall	Maureen (Moe) Flannery
	W	SS-01	Man's Best Friend: A 7000 Year Old Dog Burial in the Great Basin	Rachel K. Delovio
	W	SS-01	Zinacantec Tunic	Lori Benson
11:45	A	SY-03	Discussion	
	B	GS-01	Do Storage Temperatures Affect DNA Quality of Samples in Genetic Resource Collections?	Taylor J. Soniat
	C	GS-01	We're Hosed: Managing Risk During Early Planning	Casey A. Gallagher
	W	SS-01	Rediscovering Iris the Ichthyosaur: The <i>Shonisaurus popularis</i> Type Specimen at the Nevada State Museum, Las Vegas	Sali A. Underwood
	W	SS-01	American Purple Gallinule: An Unlikely Representative of Northwoods Biodiversity	Mollie Krebs

Noon to 1:30	A		Wednesday May 29th SPNHC Presentations by time Continued Lunch	
	B			
	C			
	W			
1:30	A	SY-06	Welcome to Symposium SY-06 Collecting Measures Of Success	
	B	GS-01	Export Compliance Issues in Natural History Collections	Amanda Robinson
	C	GS-01	The Mission for the Next Generation: New Permanent Exhibitions for Natural History Collections in National Museum, Prague, Czech Republic	Ivo Macek
	W	CDC	CDC Symposium: Importation of Potentially Infectious Specimens: Striking a Balance between Safety and Research	Adam Ferguson
1:45	A	SY-06	Measuring Impact by Empowering Users to Illustrate the Effort They Put in Natural History Collections	David P. Shorthouse
	B	SY-11	The National Meteorite Collection – From Allende to Zagami -	Julie Hoskin
	C	GS-01	Making Hay While the Sun Shines at the University of Puerto Rico Museum of Zoology	Janelle A. Peña Jimenez
	W	CDC	Overview of CDC Import Permit Program	Glen Degruy
2:00	A	SY-06	A Proposed Metadata Standard for Recording and Sharing Attribution Information	Anne E. Thessen
	B	SY-11	Just Smash It! Sampling Techniques of Meteorites for Destructive Analysis	James L. Holstein
	C	GS-01	Research, Curatorial and Outreach Opportunities at the Mammals' Collection, Instituto Alexander von Humboldt, Colombia (IAvH-M)	Andrés J. Lozano-Florez
	W	CDC	Importation Requirements for Bats and Non-Human Primates	Meredith Pyle
2:15	A	SY-06	Success Metrics In Arctos (and What We Hope to Build)	Teresa J. Mayfield-Meyer
	B	SY-14	Best Practices for Destructive Sampling in Vertebrate Palaeontology	Thomas M. Cullen
	C	GS-01	CSIRO's National Biological Collections as 21st Century Research Infrastructure	Andrew G. Young
	W	CDC	Inspection of Facilities Importing Potentially Infectious Agents	Thomas Cremer
2:30	A	SY-06	Determining What Counts in Academia – Insights from a Small University Museum	Carrie A. Eaton
	B	SY-14	Don't Touch the Pretty Ones: Destructive Sampling Protocols in the Canadian Museum of Nature's Mineral Collection	Erika B. Anderson
	C	GS-01	The Value of the Invaluable: The Challenge of Making a Scientific Collection Visible Through its Economic Estimation	M. Alejandra Camacho
	W	CDC	Implementation of the New eIPP Online Permit Application System	Thomas Cremer & Meredith Pyle
2:45	A	SY-06	Dashboard Confessionals: Obstacles and Challenges to Measuring the Success of a National Scale Digitization Program	Deborah L. Paul
	B	SY-14	Reading the Layers - Destructive Sampling of Marine Mammal Specimens at the California Academy of Sciences.	Maureen (Moe) Flannery
	C	GS-01	Rabor Wildlife Collection: Today's Record for Understanding Remarkable Biodiversity of the Philippine Islands	Juan Carlos T. Gonzalez
	W	CDC	Best Practices for Transporting Hazardous Materials	Neal Suchak
3:00	A	SY-06	Tweaking the System: Using e-Journal Technology and Existing Citation Tools to Increase the Visibility and Measurable Impact of Museums, Curation and Specimen-Based data	Christopher J. Marshall
	B	SY-14	Non-Destructive Destructive Sampling: The Uses and Limitations of Computed Tomography (CT) for Traditionally Destructive Investigations	Stephanie M. Smith
	C	GS-01	The Zoological Collections at The Instituto De Biología, Universidad Nacional Autónoma De México (IB UNAM)	Alejandro Zaldívar-Riverón
	W	CDC	Importing Potentially Infectious Materials for Natural History Museums: A (Mammal) Collection Manager Perspective	Adam Ferguson
3:15	A		Coffee Break	
	B			
	C			
	W			
3:30	A	SY-06	Measuring Success for Collections: Educational Products and Outcomes	Anna K. Monfils
	B	GS-01	Unlocking the Potential in Backlogs: A Case Study of Holistic Sampling on Frozen Backlog Specimens	Amanda N. Lawrence
	C	GS-01	Collections Make Connections at the Iziko South African Museum	Zaituna Skosan
	W	SY-09	Collections Assessment Methodology and Impact on Management and Decision-Making: A Discussion on Uses and Lessons Learned.	Carol R. Butler
	A	SY-06	From Scraps to Cache: A Case for Structured Education Collections	Kimberly J. Cook
	B	GS-01	Using The Swat Team Concept to Address Collections Backlogs	William F. Simpson

3:45	C	GS-01	From Butterflies to Ichthyosaurs the Importance of the Nevada State Museum, Las Vegas Natural History Collections	Sali A. Underwood
	W	SY-09	Collections Assessment Methodology and Impact on Management and Decision-Making: A Discussion on Uses and Lessons Learned.	Carol R. Butler
4:00	A	SY-06	International Discussion and Panel	
	B	GS-01	Processing Historic Backlog: Lessons Learned	Mare Nazaire
	C	GS-01	The Largest Terrestrial Arthropod collection in the Philippines: History, Status and Prospect	Jeremy Carlo B. Naredo
	W	SY-09	Collections Assessment Methodology and Impact on Management and Decision-Making: A Discussion on Uses and Lessons Learned.	Carol R. Butler
4:15	A	SY-06	International Discussion and Panel	
	B			
	C	GS-01	The Australian National Insect Collection: An Ever-Growing International Hub for Entomological Science	Federica Turco
	W	SY-09	Collections Assessment Methodology and Impact on Management and Decision-Making: A Discussion on Uses and Lessons Learned.	Carol R. Butler
4:30	A	SY-06	International Discussion and Panel	
	B			
	C	GS-01	The Status of the Philippine National Museum's Entomological Collections and the Management's shift towards Better Collections Management	Perry Archival C. Buenavente
	W	SY-09	Naturalis: Collection Management for the 21st Century	Christel Schollaardt
4:45	A	SY-06	International Discussion and Panel	
	B			
	C			
	W	SY-09	Discussion	
5:00	A			
	B			
	C			
	W			
5:15	A	Get ready for the Vendor's Lake Michigan Cruise		
	B			
	C			
	W			

Thursday May 30 - Continental Ballroom A			
Time	Symp	Title	Presenter
8:00	SY-15	How Disturbance History Affects Lichen and Bryophyte Diversity in Two on-Campus Old Growth Forests	Allen W. Milby
8:15	SY-15	Connections with Collections	Ben N. Spitz
8:30	SY-15	Incorporating Technology and Multidisciplinary Thinking into University Collections	Christina A. Nelson
8:45	SY-15	Using the Virginia Tech Campus as a Laboratory for Assessing Dispersal Patterns and Biases in Land Plants	Erin Quesenberry
9:00	SY-15	Reconstructing Climate Change Responses of the Fern Genus <i>Cryptogramma</i> from the Last Glacial Maximum and Onwards	Jake E. Riney
9:15	SY-15	Establishing the Natural History Collections Club Network: Engaging Undergraduate Students in Natural History Collections	Kari M. Harris
9:30	SY-15	Informing Undergraduate-led Outreach Activities through Ethnobotanical Research on Medicinal Plants in Colonial Virginia	Ksenia A. Pereverzeva
9:45	Coffee Break		
10:00			
10:15	SY-15	A Tale of Natural History Collections Education at Virginia Tech	Rebecca K. Hawkins
10:30	SY-15	Challenges of Linking Across Disciplines: The UNM Natural History Collections Club	Serina Brady
10:45	SY-15	A New Natural History Collections Curriculum in Biological Sciences Education	Travis D. Marsico
11:00	GS-01	Natural History Collections in Liberal Arts Education	Ellen Thomas
11:15	SY-13	The Role of Small Collections in Biodiversity Research	Anna K. Monfils
11:30	SY-13	Digitization and the Contribution of Small Natural History Collections in Global Change Biology	Michael W. Belitz
11:45	SY-13	Research Contributions and Digitization Progress of Regional Herbaria	Blake C. Cahill
Noon to 1:30pm Lunch			
1:30	SY-13	Small Herbaria Significantly Contribute Unique Biogeographic Records to County-, Locality-, and Temporal-Level Scales	Travis D. Marsico
1:45	SY-13	Avian Pediatrics: Why Eggs and Small Collections Can Be an Essential Scientific Resource Now and into the Future.	John M. Bates
2:00	SY-13	Patchwork Patterns and Widescale Worth: Small Paleontology Museums are Local Linchpins	Jess Miller-Camp
2:15	SY-13	Big Heads or Long Tails: How Smaller Fish Collections Contribute to Collections-Based Biodiversity Research	Randal A. Singer
2:30	SY-13	Life after Death: Modern Research on a Historical Mussel Collection.	Julia B. Colby
2:45	SY-13	Small Mammal Collections in the 21st Century: Impacts on Research Require Growing Genomic Resources and Establishing Data Availability	Marcia A. Revelez
3:00	SY-13	Small Entomology Collections: An Update on their Status and Contributions to Collections-Based Research	Jennifer M. Zaspel
3:15	Coffee Break		
3:30	SY-13	If a Small Collection Exists in the Forest, Does Anybody Know It's There? Research Value and Digitization Progress of Field Station Collections	Erica Krimmel
3:45	SY-13	OGL's Marine DNA Bank: Important Applications to Conservation and Seafood Security	Hannah Appiah-Madson
4:00	SY-13	Digitally Vouchered Specimens in the myFOSSIL eMuseum	Jennifer E. Bauer
4:15	SY-13	Arctos: A Tool to Help Small Collections Make Their Case	Teresa J. Mayfield-Meyer
4:30	SY-13	Unlocking Natural History at the Chicago Academy of Sciences	Dawn R. Roberts
4:45	SY-13	Small Collections in the Era of Big Data and ADBC	Molly A. Phillips
5:00			
5:15	Discussion		

Thursday May 30 - Continental Ballroom B			
Time	Symp	Title	Presenter
8:00	SY-05	Digitizing the Field Museum's Fossil Invertebrate Collection	Paul Mayer
8:15	SY-05	Digitizing the history of the Ordovician: between a rock and a new building.	Patricia Coorough Burke
8:30	SY-05	Balancing Efficiency and Accuracy in the NHMLA Invertebrate Paleontology Collection	Erica Krimmel
8:45	SY-05	Bringing Microfossil Specimens into the Light: Using Semi-Automated Digitization Techniques to Improve Collection Accessibility	Emily D. Thorpe
9:00	SY-05	Kit-Bashing Camera Code: Lessons in Developing Auto-Assist Tools to Compliment the GIGAmacro Photography System	Alex Zimmerman
9:15	SY-05	Cretaceous World TCN: Digitizing the Western Interior Seaway at the Yale Peabody Museum	Elissa S. Martin
9:30	GS-01	Catching up on Vertebrate Paleontology Loans: Groundtruthing for Success	Adrienne M. Stroup
9:45	Coffee Break		
10:00	Coffee Break		
10:15	SY-05	Overdue Loans: How Do We Get Our Specimens Back?	Jessica D. Cundiff
10:30	SY-05	Digitization and Management of the National Museum of Natural History, Invertebrate Zoology Collections: Challenges, Workflows, and Solutions	William E. Moser
10:45	SY-05	Standardization and Data Flexibility: Lessons Learned from Digitization of a large Lepidoptera Natural History Collection	Laurel Kaminsky
11:00	SY-05	Mass Digitization of a Historic Histological Slide Collection: Challenges and Insights	Peter Giere
11:15	SY-05	Second Mass Digitisation Project for the Herbarium (BR) at the Meise Botanic Garden: Same Same but Different	Henry R. Engledow
11:30	SY-05	Large Institutions' Post-TCN Struggles with Data Maintenance	Genevieve E. Tocci
11:45	SY-05	"Born Digital," Enabling a Field-to-Database Workflow for Herbaria	Caleb A. Powell
Noon to 1:30pm Lunch			
1:30	SY-05	Opening up the Collection of MfN	Frederik Berger
1:45	SY-05	Transforming Accession and Field Books at the Illinois Natural History Survey Insect Collection into Powerful Metadata Depictions	Thomas C. McElrath
2:00	SY-05	Do We Really Want to Do This Again!?: Taking Advantage of Aggregators to Harvest Existing Digital Data to Efficiently Grow Your Natural History Collection	Dina Clark
2:15	SY-04	Crowdsourcing Digitization and Curation: Transformative Models for Community Science Engagement Connecting Natural History Collections to Biodiversity Research and Education	Matt J. von Konrat
2:30	SY-04	Strategic Planning for the Worldwide Engagement for Digitizing Biocollections (WeDigBio) Project	Austin Mast
2:45	SY-04	Defining the Purpose of Public Participation Events: The Key to Desired Outcomes	Gil M. Nelson
3:00	SY-04	Five Years of Collaboratively Digging Bio: WeDigBio 2015-2019	Libby Ellwood
3:15	Coffee Break		
3:30	SY-04	Notes from Nature: A Citizen Science Platform in Support of Biodiversity Research	Michael W. Denslow
3:45	SY-04	A Collections Perspective: A Case Study on the Benefits and Costs of Using Crowdsourced Transcription Services.	Simon Checksfield
4:00	GS-01	Good Enough? A Realistic Approach to Citizen Science Microfossil Sorting at La Brea Tar Pits and Museum	Austin Mast
4:15	SY-08	Customized Boxes for Human Remains and Associated Grave Goods	Amy L. Covell-Murthy
4:30	SY-08	Salix Shoots and Falconidae Feathers: Anthropology Collections are Natural History Collections	Laura Eklund
4:45	GS-01	Connecting with the Modern Maya: The Chiapas Digitization Project	Lori Benson
5:00	GS-01	Connected to the Community: Managing and Preserving Natural History Specimens with Strong Cultural or Emotional Links to the Public.	Nyssa D. Mildwaters

Thursday May 30 - Continental Ballroom C			
Time	Symp	Title	Presenter
8:00	GS-01	Extending U.S. Biodiversity Collections to Address National Challenges	Barbara M. Thiers
8:15	GS-01	Impacts of Big Data Quality and Error in Digitized Collections	Anna Chinn
8:30	GS-01	Dark Matter Matters	Brendan J. Lepschi
8:45	GS-01	BIOSPEX 3.0—A Basecamp for Launching, Advertising, and Managing Biodiversity Specimen Digitization Expeditions	Austin Mast
9:00	GS-01	The International Specify Collections Consortium	James H. Beach
9:15	GS-01	Dreaming of a Museum: Significance of Addressing the "Wallacean Shortfall" and "Linnean Shortfall" in a Biodiversity Hotspot	Vijayakumar Seenapuram Palaniswamy
9:30	GS-01	Casting a Wider Net: The Promise of Digital Transcription for Data Archiving and Dissemination	Gabriela M. Hogue
9:45	Coffee Break		
10:00			
10:15	GS-01	Transparency About Origins and Uses: Tracking Permits and Other Legal Compliance Documentation in Collection Management Systems	Breda M. Zimkus
10:30	GS-01	The Role of Natural History Collection Databases and Historic DNA in Conservation from Texas to the United Kingdom	Kelcee L. Smith
10:45	GS-01	Maintenance, Migration, and Adaptation: Developing Best Practices for the Curation of Natural History Collections Databases	Andrea K. Thomer
11:00	GS-01	Wasps and Bees on Display – A Case Study on Live-Digitization in the Exhibition	Lukas Kirschey
11:15	GS-01	The Fossil Insect Collaborative Thematic Collection Network	Talia S. Karim
11:30	GS-01	Digital and Physical Curation of Illegally-Collected Vertebrate Fossils with Sparse, But Critical, Locality Data	Carolyn G. Levitt-Bussian
11:45	GS-01	Square One: Planning a Digitization Project of an Uncatalogued Collection from Scratch	Jackie Cooney
Noon to 1:30pm Lunch			
1:30	GS-01	A Captive Audience: Leveraging Museum Events for Formative and Summative Evaluation	Carrie A. Eaton
1:45	GS-01	Teaching Collections of T. C. Chamberlin at the Whitewater Normal School (1869-1873).	Rex A. Hanger
2:00	GS-01	Encouraging Women in Science Programs: An Intern's Perspective	Dana A. Kahn
2:15	GS-01	'Snapshots in Time' – Leveraging Natural History Collections to Inform and Communicate Science: A Case Study Featuring African leopards (<i>Panthera pardus</i>) and wolves (<i>Canis lupus</i>) of the Greater Yellowstone Ecosystem.	Corey A. Anco
2:30	GS-01	Experiential Learning through Natural History Collections for Undergraduates	Adania Flemming
2:45	GS-01	Demo Camp: New Approaches to Volunteer Training in Specimen Preparation	Erin L. Berkowitz
3:00	GS-01	Collecting Memories: Using Natural History Collections to Connect Vulnerable Adults with Memory and Cognitive Enrichment	Melody Basham
3:15	Coffee Break		
3:30	GS-01	Natural History Collections as Interdisciplinary Crossroads	Emily P. Smith
3:45	GS-01	Robert Brown - Disentangling the History of Specimens of a Scottish Explorer in the Herbarium of the Royal Botanic Garden Edinburgh	Elsbeth Haston
4:00	GS-01	A Shout Out for Cultivated Plant Collections	Mandeep Matharu
4:15	GS-01	All Grasses Great and Small: Reorganizing and Rehousing the Poaceae Collection at the US National Herbarium	Meghann Toner
4:30	GS-01	Linking Indigenous Botanical Knowledge with Western Science Plant Names	Linda Broadhurst
4:45	GS-01	Collection BioBlitz: Enhance and Broaden Undergraduate to Graduate Learning Experiences with University of British Columbia, Beaty Biodiversity Herbarium Specimens	Linda Jennings

Thursday May 30 - Waldorf Room			
Time	Symp	Title	Presenter
8:00	DC-01	BRIT Digitization Appliance	Jason H. Best
8:15			
8:30	DC-01	Software for Fast High Quality Transcription of Millions of Digitized Herbarium Specimens	Frank Veldhuizen
8:45			
9:00	DC-01	Fast Prototypes for Collection Data Enhancement: GBIF Issue Explorer, Location and Name Matching Using Approximate Strings	Luis J. Villanueva
9:15			
9:30	DC-01	Advanced Collection Management Using Arctos: Publications and Projects Demonstrate a Collection's Impact.	Aren M. Gunderson
9:45			
10:00	Coffee Break		
10:15 to Noon	Arctos Working Group meeting		
Noon to 1:30pm	Lunch		
1:30	Welcome To Specimen Spotlight		
1:35	SS-02	From Finwhale to Finishing - The Redevelopment of UMZC	Mathew W. Lowe
1:40	SS-02	A Q?rius Pangolin: Odd Mammal, Perfect Teaching Tool	Kelsey Falquero
1:45	SS-02	A very Rare Arboreal Spiny Rat	Andrés J. Lozano-Flórez
1:50	SS-02	Enigmatic Dinagat Gymnure	Juan Carlos T. Gonzalez
1:55	SS-02	Stuffing a New Endangered Southern Cassowary	Alison P. Douglas
2:00	SS-02	A Curious Cardinal	Jacquelyn Whisenant
2:05	SS-02	Crocodile Icefish from the Stomach of Antarctic Toothfish	Oliver D. Orr
2:10	Mini break 5 minutes		
2:15	SS-02	A Glass Model of Land Snail Anatomy	Jochen Gerber
2:20	SS-02	Family Tree: Preserving a Legacy, a Collection, and the Coral Reefs	Devon E. Lee
2:25	SS-02	A New Species of Phytophagous Braconid wasp (Doryctinae: <i>Allorhogas</i>) Attacking Fruits/Seeds on <i>Miconia chamissois</i> Naudin	Alejandro Zaldívar-Riverón
2:30	SS-02	<i>Amerodectes jonesborensis</i> : Who 'Mite' That Be?	Kevin J. Krajcir
2:35	SS-02	An Extremely Rare Specimen Collected in JoDavies Co. in Northwest Illinois.	James Louderman
2:40	SS-02	Blue Banded Bees as Biosensors	Andrew G. Young
2:45	SS-02	3D Prints Tell Human Stories	Katherine Roberts
2:50	SS-02	Feather Earring from Northern California	Laura Eklund
2:55	SS-02	Banks' Collector and the Aboriginal Guide: An Early Eucalypt Specimen from the Colony of Sydney	Shelley A. James
3:00	SS-02	Specimen Woods and Trunk Photographs Illustrating the Tree Flora of Illinois, Created by Benjamin T. Gault, 1899-1901	Dawn Roberts
3:05	SS-02	A New Plant Genus from a Cabinet of Curiosities	Emily Magnaghi
3:10	SS-02	<i>Rhododendron yakushmanum</i> 'Koichiro Wada'	Yvette B. Harvey
3:15	Coffee Break 15 minutes		
3:30	SS-02	A Lonely Branch on a Mountain Top	Vijayakumar Seenapuram Palaniswamy
3:35	SS-02	Every Label Tells a Story...or Two, or Three	Tonya M. Haff
3:40	SS-02	(Re)blazing Stars in the Mississippi Alluvial Plain of Arkansas	Diana L. Soteropoulos
3:45	SS-02	Hamilton and The Sickener	Amber R. Reaney
3:50	SS-02	<i>Gymnocactus subterraneus</i> : A Tale of Two Types	Mare Nazaire
3:55	Mini break 5 minutes		
4:00	SS-02	<i>Dictyorhabdus priscus</i> : What is it and What Can it Teach Us?	Ellen Thomas
4:05	SS-02	FMNH2211: The Hard Life of a Young Tyrannosaur	Thomas M. Cullen
4:10	SS-02	Using Your Head: MPM 8111 and the Pachycephalosaur Debate	Kathryn Pauls
4:15	SS-02	Field Museum's First New Dinosaur	William F. Simpson
4:20	SS-02	Amethyst <i>Allosaurus</i>	Carolyn G. Levitt-Bussian
4:25	SS-02	<i>Anchiornis huxleyi</i> : The Feathered Dinosaur that Flew the Coop	Linsly J. Church
4:30	SS-02	A Collaborative Path to Science	Bruce H. Lauer
4:35	SS-02	CM 76867, <i>Fedexia striegeli</i> : Pittsburgh's Late Paleozoic Treasure	Amy C. Henrici
4:40	SS-02	Don't Throw Your Specimens Out of A Window: Resurrecting IU's lost <i>Megalonyx jeffersonii</i>	Polly R. Sturgeon
4:45	SS-02	19-Ton Lake Superior Copper Nugget	Helen J. DeMarsh

Posters Thursday May 30th - Astoria Room		
#	Title	Presenter
1	Methods of Determining Formalin Concentration in Fluid Preservatives	Irene F. Finkelde
2	Testing the Effect of Denatured Alcohol on the Preservation of Zoological Wet Collections	Edda Aßel
3	Curation of the Florida Museum of Natural History's Fluid-Preserved Mammal Collection: Lessons Learned for Future Curation Efforts	Verity Mathis
4	Developments on rehousing the ethanol collections at the Academy of Natural Sciences of Drexel University.	Nasreen Aziz
5	Workflows for Sampling Museum Specimens and Cataloging Genetic Samples	Katie F. Ahlfeld
6	What We Did With 7,500 Bags of Dried Grass	Christopher J. Huddleston
7	The Partnership of BOEM-ESP and Smithsonian NMNH-IZ: 40 Years of Collaboration and Expansion	Marshall H. Boyd
8	Increasing Discoverability of Natural History Genomic Resources through the Arctos / GGBN Collaboration	Kyndall B.P. Hildebrandt
9	Upgrades to the University of Alaska Museum's Genomic Resources Facility and a Novel Space-Saving Cryotube Design	Kyndall Hildebrandt
10	The Role of Earth Science Collections within Biodiversity Research	Jiri Frank
11	Why 'Mite' Feather Mites Be Important? And How Can Collections Help Guide Research?	Kevin J. Krajcir
12	Shape Diversity and Evolution of Catfishes (Order Siluriformes)	Milton Tan
13	Telling the History of Monterey Through Herbarium Collections	Ann M. Bishop
14	Evaluating Fungal Data from Canadian Parks	Jennifer Wilkinson
15	Canadian Collection of Fungal Cultures: Contraction, Construction and Containment.	Tara L. Rintoul
16	Fungarium Feasting: Which Pests are Eating Mycological Collections?	Genevieve E. Tocci
17	Rare and Interesting Plants Recorded in Poinsett County, Arkansas.	Jennifer N. Reed
18	Curating the Anderson-Cutler Maize Collection: Problems and Solutions	Taryn Pelch
19	Strategies for Associating the Dissociated at the National Collection of Vascular Plants (DAO)	Kelsey Joustra
20	Improving Environmental Conditions in the Archaeology Collections at Bishop Museum	Charmaine Wong
21	Making Sense of a Hot Mess: The Case for Archives in Anthropology	Emily E. Dahlin
22	Helping the Herps: Restoring the Past for A-State's Future	Grant T. Dawson
23	Portland State University Museum of Vertebrate Biology: From Endangered to Organized	Cecily Bronson
24	Imperfections on Display: Piloting a University Marine Science Exhibit with the Pathological Skeleton of a Bottlenose Dolphin (<i>Tursiops truncatus</i>)	Danielle N. Ingle
25	Getting the Hang of It: Storage and Display Improvements for Suspended Vertebrate Specimens at the Michigan State University Museum	Laura M. Abraczinskas
26	Unossified Skeletal Preparation: Challenges and Applications	Andrea M. Carrillo
27	Osteological Ink: Comparing Pens for use in Labeling Osteological Collections	Jacquelyn Whisenant
28	Continued Care and Use of Specialized Legacy Collections Following Curator Retirement: A Case Study of the KU Invertebrate Zoology Collection	Vanessa Delnavaz
29	Colorful Crustacea: Restoring and Recoloring Crustacean Specimens for Permanent Display	Madison E. Mayfield
30	Preserving the Dry Coral Collection at the American Museum of Natural History	Devon E. Lee
31	Rehabilitation of the University of California Museum of Paleontology Miocene Amber Collection from Chiapas, Mexico	Diane M. Erwin
32	Extra-Terrestrial Conservation: Storing the Cranbourne Meteorites	Gretchen E. Anderson
33	CM Risk Assessment Project 2019 - A Progress Report	Arne P. Johnson
34	Diversification and niche evolution in Neotropical <i>Tibouchina</i> s.s. (Melastomataceae)	Johanna Jantzen

Thursday May 30th SPNHC Presentations by time				
Time	R m	Sym	Title	Presenter
7:45	A	SY-15	Welcome to Symposium SY-15 Broadening Participation of Students in Biodiversity Collections through a Network of Student Clubs	
	B	SY-05	Welcome to Symposium SY-05 Managing And Digitizing Large Collections	
	C	GS-01	Welcome to General Session Talks Day Two	
	W	Demo	Welcome to the Demo Camps	
8:00	A	SY-15	How Disturbance History Affects Lichen and Bryophyte Diversity in two on-Campus Old Growth Forests	Allen W. Milby
	B	SY-05	Digitizing the Field Museum's Fossil Invertebrate Collection	Paul Mayer
	C	GS-01	Extending U.S. Biodiversity Collections to Address National Challenges	Barbara M. Thiers
	W	Demo	BRIT Digitization Appliance	Jason H. Best
8:15	A	SY-15	Connections with Collections	Ben N. Spitz
	B	SY-05	Digitizing the History of the Ordovician: Between a Rock and a New Building	Patricia Coorough Burke
	C	GS-01	Impacts of Big Data Quality and Error in Digitized Collections	Anna Chinn
	W	Demo	BRIT Digitization Appliance	Jason H. Best
8:30	A	SY-15	Incorporating Technology and Multidisciplinary Thinking into University Collections	Christina A. Nelson
	B	SY-05	Balancing Efficiency and Accuracy in the NHMLA Invertebrate Paleontology Collection	Erica Krimmel
	C	GS-01	Dark Matter Matters	Brendan J. Lepschi
	W	Demo	Demonstration of New Transcribing Software: DETA	Frank Veldhuizen
8:45	A	SY-15	Using the Virginia Tech Campus as a Laboratory for Assessing Dispersal Patterns and Biases in Land Plants	Erin Quesenberry
	B	SY-05	Bringing Microfossil Specimens into the Light: Using Semi-Automated Digitization Techniques to Improve Collection Accessibility	Emily D. Thorpe
	C	GS-01	BIOSPEX 3.0—A Basecamp for Launching, Advertising, and Managing Biodiversity Specimen Digitization Expeditions	Austin Mast
	W	Demo	Demonstration of New Transcribing Software: DETA	Frank Veldhuizen
9:00	A	SY-15	Reconstructing Climate Change Responses of the Fern Genus <i>Cryptogramma</i> from the Last Glacial Maximum and Onwards	Jake E Riney
	B	SY-05	Kit-Bashing Camera Code: Lessons in Developing Auto-Assist Tools to Compliment the GIGAmacro Photography System	Alex Zimmerman
	C	GS-01	The International Specify Collections Consortium	James H. Beach
	W	Demo	Fast Prototypes for Collection Data Enhancement: GBIF Issue Explorer, Location and Name Matching Using Approximate Strings	Luis J. Villanueva
9:15	A	SY-15	Establishing the Natural History Collections Club Network: Engaging Undergraduate Students in Natural History Collections	Kari M. Harris
	B	SY-05	Cretaceous World TCN: Digitizing the Western Interior Seaway at the Yale Peabody Museum	Elissa S. Martin
	C	GS-01	Dreaming of a Museum: Significance of Addressing the "Wallacean Shortfall" and "Linnean Shortfall" in a Biodiversity Hotspot	Vijayakumar Seenapuram Palaniswamy
	W	Demo	Fast Prototypes for Collection Data Enhancement: GBIF Issue Explorer, Location and Name Matching Using Approximate Strings	Luis J. Villanueva
9:30	A	SY-15	Informing Undergraduate-Led Outreach Activities through Ethnobotanical Research on Medicinal Plants in Colonial Virginia	Ksenia A. Pereverzeva
	B	GS-01	Catching up on Vertebrate Paleontology Loans: Groundruthing for Success	Adrienne M. Stroup
	C	GS-01	Casting a Wider Net: The Promise of Digital Transcription for Data Archiving and Dissemination	Gabriela M. Hogue
	W	Demo	Advanced Collection Management Using Arcos: Publications and Projects Demonstrate a Collection's Impact.	Aren M. Gunderson
9:45	A	Coffee Break		
	B			
	C			
	W	Demo	Advanced Collection Management Using Arcos: Publications and Projects Demonstrate a Collection's Impact.	Aren M. Gunderson
10:00	A	Coffee Break		
	B			
	C			
	W			

10:15	A	SY-15	A Tale of Natural History Collections Education at Virginia Tech	Rebecca K. Hawkins
	B	SY-05	Overdue Loans: How Do We Get Our Specimens Back?	Jessica D. Cundiff
	C	GS-01	Transparency about Origins and Uses: Tracking Permits and Other Legal Compliance Documentation in Collection Management Systems	Breda M. Zimkus
	W	ARCT	Arctos Working Group meeting	Mariel Campbell
10:30	A	SY-15	Challenges of Linking Across Disciplines: The UNM Natural History Collections Club	Serina Brady
	B	SY-05	Digitization and Management of the National Museum of Natural History, Invertebrate Zoology Collections: Challenges, Workflows, and Solutions	William E. Moser
	C	GS-01	The Role of Natural History Collection Databases and Historic DNA in Conservation from Texas to the United Kingdom	Kelcee L. Smith
	W	ARCT	Arctos Working Group meeting	Mariel Campbell
10:45	A	SY-15	A New Natural History Collections Curriculum in Biological Sciences Education	Travis D. Marsico
	B	SY-05	Standardization and Data Flexibility: Lessons Learned from Digitization of a large Lepidoptera Natural History Collection	Laurel Kaminsky
	C	GS-01	Maintenance, Migration, and Adaptation: Developing Best Practices for the Curation of Natural History Collections Databases	Andrea K. Thomer
	W	ARCT	Arctos Working Group meeting	Mariel Campbell
11:00	A	GS-01	Natural History Collections in Liberal Arts Education	Ellen Thomas
	B	SY-05	Mass Digitization of a Historic Histological Slide Collection: Challenges and Insights	Peter Giere
	C	GS-01	Wasps and Bees on Display – A Case Study on Live-Digitization in the Exhibition	Lukas Kirschey
	W	ARCT	Arctos Working Group meeting	Mariel Campbell
11:15	A	SY-13	The Role of Small Collections in Biodiversity Research	Anna K. Monfils
	B	SY-05	Second Mass Digitization Project for the Herbarium (BR) at the Meise Botanic Garden: Same Same but Different	Henry R. Engledow
	C	GS-01	The Fossil Insect Collaborative Thematic Collection Network	Talia S. Karim
	W	ARCT	Arctos Working Group meeting	Mariel Campbell
11:30	A	SY-13	Digitization and the Contribution of Small Natural History Collections in Global Change Biology	Michael W. Belitz
	B	SY-05	Large Institutions' Post-TCN Struggles with Data Maintenance	Genevieve E. Tocci
	C	GS-01	Digital and Physical Curation of Illegally-Collected Vertebrate Fossils with Sparse, But Critical, Locality Data	Carolyn G. Levitt-Bussian
	W	ARCT	Arctos Working Group meeting	Mariel Campbell
11:45	A	SY-13	Research Contributions and Digitization Progress of Regional Herbaria	Blake C. Cahill
	B	SY-05	"Born Digital," Enabling a Field-to-Database Workflow for Herbaria	Caleb A. Powell
	C	GS-01	Square one: Planning a Digitization Project of an Uncatalogued Collection from Scratch	Jackie Cooney
	W	ARCT	Arctos Working Group meeting	Mariel Campbell
Noon	A	Lunch		
	B			
	C			
	W			
1:30	A	SY-13	Small Herbaria Significantly Contribute Unique Biogeographic Records to County-, Locality-, and Temporal-Level Scales	Travis D. Marsico
	B	SY-05	Opening up the Collection of MfN	Frederik Berger
	C	GS-01	A Captive Audience: Leveraging Museum Events for Formative and Summative Evaluation	Carrie A. Eaton
	W	SS_02	Welcome Specimen Spotlight	
	W	SS-02	From Finwhale to Finishing - The Redevelopment of UMZC	Mathew W. Lowe
	W	SS-02	A Q?rius Pangolin: Odd Mammal, Perfect Teaching Tool	Kelsey Falquero
1:45	A	SY-13	Avian Pediatrics: Why Eggs and Small Collections Can Be an Essential Scientific Resource Now and into the Future.	John M. Bates
	B	SY-05	Transforming Accession and Field Books at the Illinois Natural History Survey Insect Collection into Powerful Metadata Depictions	Thomas C. McElrath
	C	GS-01	Teaching Collections of T. C. Chamberlin at the Whitewater Normal School (1869-1873).	Rex A. Hanger
	W	SS-02	A very Rare Arboreal Spiny Rat	Andrés J. Lozano-Flórez
	W	SS-02	Enigmatic Dinagat Gymnure	Juan Carlos T. Gonzalez
	W	SS-02	Stuffing a New Endangered Southern Cassowary	Alison P. Douglas
	A	SY-13	Patchwork Patterns and Widescale Worth: Small Paleontology Museums are Local Linchpins	Jess Miller-Camp

2:00	B	SY-05	Do We Really Want to Do This Again!? Taking Advantage of Aggregators to Harvest Existing Digital Data to Efficiently Grow Your Natural History Collection	Dina Clark
	C	GS-01	Encouraging Women in Science Programs: An Intern's Perspective	Dana A. Kahn
	W	SS-02	A Curious Cardinal	Jacquelyn Whisenant
	W	SS-02	Crocodile Icefish from the Stomach of Antarctic Toothfish	Oliver D. Orr
	W	SS-02	Mini Break	
2:15	A	SY-13	Big Heads or Long Tails: How Smaller Fish Collections Contribute to Collections-Based Biodiversity Research	Randal A. Singer
	B	SY-04	Crowdsourcing Digitization and Curation: Transformative Models for Community Science Engagement Connecting Natural History Collections to Biodiversity Research and Education	Matt J. von Konrat
	C	GS-01	'Snapshots in Time' – Leveraging Natural History Collections to Inform and Communicate Science: A case study Featuring African Leopards (<i>Panthera pardus</i>) and Wolves (<i>Canis lupus</i>) of the Greater Yellowstone Ecosystem.	Corey A. Anco
	W	SS-02	A Glass Model of Land Snail Anatomy	Jochen Gerber
	W	SS-02	Family Tree: Preserving a Legacy, a Collection, and the Coral Reefs	Devon E. Lee
	W	SS-02	A New Species of Phytophagous Braconid Wasp (Doryctinae: <i>Allorhogas</i>) Attacking Fruits/Seeds on <i>Miconia chamissois</i> Naudin	Alejandro Zaldívar-Riverón
2:30	A	SY-13	Life after Death: Modern Research on a Historical Mussel Collection.	Julia B. Colby
	B	SY-04	Strategic Planning for the Worldwide Engagement for Digitizing Biocollections (WeDigBio) Project	Austin Mast
	C	GS-01	Experiential Learning through Natural History Collections for Undergraduates	Adania Flemming
	W	SS-02	<i>Amerodectes jonesborensis</i> : Who 'Mite' That Be?	Kevin J. Krajcir
	W	SS-02	An Extremely Rare Specimen Collected in JoDaviess Co. in Northwest Illinois.	James Louderman
	W	SS-02	Blue Banded Bees as Biosensors	Andrew G. Young
2:45	A	SY-13	Small Mammal Collections in the 21st Century: Impacts on Research Require Growing Genomic Resources and Establishing Data Availability	Marcia A. Revelez
	B	SY-04	Defining the Purpose of Public Participation Events: The Key to Desired Outcomes	Gil M. Nelson
	C	GS-01	Demo Camp: New Approaches to Volunteer Training in Specimen Preparation	Erin L. Berkowitz
	W	SS-02	3D Prints Tell Human Stories	Katherine Roberts
	W	SS-02	Feather Earring from Northern California	Laura Eklund
	W	SS-02	Banks' Collector and the Aboriginal Guide: An Early Eucalypt Specimen from the Colony of Sydney	Shelley A. James
3:00	A	SY-13	Small Entomology Collections: An Update on their Status and Contributions to Collections-Based Research	Jennifer M. Zaspel
	B	SY-04	Five Years of Collaboratively Digging Bio: WeDigBio 2015-2019	Libby Ellwood
	C	GS-01	Collecting Memories: Using Natural History Collections to Connect Vulnerable Adults with Memory and Cognitive Enrichment	Melody Basham
	W	SS-02	Specimen Woods and Trunk Photographs Illustrating the Tree Flora of Illinois, Created by Benjamin T. Gault, 1899-1901	Dawn Roberts
	W	SS-02	A New Plant Genus from a Cabinet of Curiosities	Emily Magnaghi
	W	SS-02	<i>Rhododendron yakushmanum</i> 'Koichiro Wada'	Yvette B. Harvey
3:15	A	Coffee Break		
	B			
	C			
	W			
3:30	A	SY-13	If a Small Collection Exists in the Forest, Does Anybody Know It's There? Research Value and Digitization Progress of Field Station Collections	Erica Krimmel
	B	SY-04	Notes from Nature: A Citizen Science Platform in Support of Biodiversity Research	Michael W. Denslow
	C	GS-01	Natural History Collections as Interdisciplinary Crossroads	Emily P. Smith
	W	SS-02	A Lonely Branch on a Mountain Top	Vijayakumar Seenapuram Palaniswamy
	W	SS-02	Every Label Tells a Story...or Two, or Three	Tonya M. Haff
	W	SS-02	(Re)blazing Stars in the Mississippi Alluvial Plain of Arkansas	Diana L. Soteropoulos
	A	SY-13	OGL's Marine DNA Bank: Important Applications to Conservation and Seafood Security	Hannah Appiah-Madson
	B	SY-04	A Collections Perspective: A Case Study on the Benefits and Costs of Using Crowdsourced Transcription Services.	Simon Checksfield

3:45	C	GS-01	Robert Brown - Disentangling the History of Specimens of a Scottish Explorer in the Herbarium of the Royal Botanic Garden Edinburgh	Elspeith Haston
	W	SS-02	Hamilton and The Sickener	Amber R. Reaney
	W	SS-02	<i>Gymnocactus subterraneus</i> : A Tale of Two Types	Mare Nazaire
	W	SS-02	Mini break	
4:00	A	SY-13	Digitally Vouchered Specimens in the myFOSSIL eMuseum	Jennifer E. Bauer
	B	GS-01	Good Enough? A Realistic Approach to Citizen Science Microfossil Sorting at La Brea Tar Pits and Museum	Austin Mast
	C	GS-01	A Shout Out for Cultivated Plant Collections	Mandeep Matharu
	W	SS-02	<i>Dictyorhabdus priscus</i> : What is it and What Can it Teach Us?	Ellen Thomas
	W	SS-02	FMNH2211: The Hard Life of a Young Tyrannosaur	Thomas M. Cullen
4:15	W	SS-02	Using Your Head: MPM 8111 and the Pachycephalosaur Debate	Kathryn Pauls
	A	SY-13	Arctos: A Tool to Help Small Collections Make Their Case	Teresa J. Mayfield-Meyer
	B	SY-08	Customized Boxes for Human Remains and Associated Grave Goods	Amy L. Covell-Murthy
	C	GS-01	All Grasses Great and Small: Reorganizing and Rehousing the Poaceae Collection at the US National Herbarium	Meghann Toner
	W	SS-02	Field Museum's First New Dinosaur	William F. Simpson
	W	SS-02	Amethyst Allosaurus	Carolyn G. Levitt-Bussian
4:30	W	SS-02	<i>Anchiornis huxleyi</i> : The Feathered Dinosaur that Flew the Coop	Linsly J. Church
	A	SY-13	Unlocking Natural History at the Chicago Academy of Sciences	Dawn R. Roberts
	B	SY-08	Salix Shoots and Falconidae Feathers: Anthropology Collections are Natural History Collections	Laura Eklund
	C	GS-01	Linking Indigenous Botanical Knowledge with Western Science Plant Names	Linda Broadhurst
	W	SS-02	A Collaborative Path to Science	Bruce H. Lauer
4:45	W	SS-02	CM 76867, <i>Fedexia striegeli</i> : Pittsburgh's Late Paleozoic Treasure	Amy C. Henrici
	W	SS-02	Don't Throw Your Specimens Out of A Window: Resurrecting IU's lost <i>Megalonyx jeffersonii</i>	Polly R. Sturgeon
	A	SY-13	Small Collections in the Era of Big Data and ADBC	Molly A. Phillips
	B	GS-01	Connecting with the Modern Maya: The Chiapas Digitization Project	Lori Benson
5:00	C	GS-01	Collection BioBlitz: Enhance and Broaden Undergraduate to Graduate Learning Experiences with University of British Columbia, Beaty Biodiversity Herbarium Specimens	Linda Jennings
	W	SS-02	19-Ton Lake Superior Copper Nugget	Helen J. DeMarsh
	A	SY-13	Discussion	
5:15	B	GS-01	Connected to the Community: Managing and Preserving Natural History Specimens with Strong Cultural or Emotional Links to the Public.	Nyssa D. Mildwaters
	C			
	W			
5:30	A	SY-13	Discussion	
	B			
	C			
	W			
Get Ready for SPNHC Banquet				

Room	Special Events and Breakout Sessions in PDR Rooms
Wednesday Morning	
PDR 1	Linda Gottfried: Aurora Storage Recording People's Testimonials
PDR 2	
PDR 3	
PDR 4	
PDR 5	
Wednesday Afternoon	
PDR 1	Frank Veldhuizen: Alembo and Picturae live software presentation new modern Transcribing software called DETA
PDR 2	Adam Ferguson: CDC Symposium Discussion
PDR 3	
PDR 4	
PDR 5	
Thursday Morning	
PDR 1	Norine Spears: Specify Drop-In Session
PDR 2	
PDR 3	
PDR 4	
PDR 5	
Thursday Afternoon	
PDR 1	Norine Spears: Specify Drop-In Session
PDR 2	
PDR 3	
PDR 4	
PDR 5	

Friday at the Field

Friday, May 31st is the last day of the conference and everyone is invited to the Field Museum for the Annual Business Meeting. Enjoy access to the Museum's public displays all day long including SUE's new home, plus we have several special events taking place before and after the Annual Business Meeting. Listed below are the activities and a description of each. All of these activities are free to attend. Please remember to wear your badge at all times at in the Museum.

Educational Share Fair

8:30am - 11:00am

Lecture Hall 2

The share fair is an informal session meant to get feedback and ideas from people about collections-based education or outreach materials. Presenters normally bring a sample of whatever they are working on to share, but don't make a formal power point or anything. These are round-table discussions – so small group setting, which means plenty of time to go back and forth and discuss.

The Use of Biocollection Digital Data as Learning Manipulatives

Presenter: **Anne Basham**

Initially developed for LepNet (LepXplor) Project. Project uses collection digital data to develop paper relief manipulatives to enhance student understanding of evolutionary concepts and biodiversity. Currently piloting with different audiences with the goal to develop educational kits.

Underwater webcams screenshot sharing - a citizen science Facebook group

Presenter: **Randal A Singer**

Underwater webcams screenshot sharing is a Facebook group with over 1,600 members. Originally it centered around posting screenshots of wildlife livestreams among a few dozen members. In 2013 I joined the group and introduced the group to the Okeanos Explorer program and after doing a Reddit AMA the group grew to over 1k members overnight. Scientists now use member of the group to report occurrences and localities of species seen during the streams that can take place anytime within a 24-hour period. Similar resources could be created around other projects!

Walk Through Time

Presenter: **Jess Miller-Camp**

This guide will help you turn the length of a walking path into a proportional walk through geologic time and major events in the evolution of life. The purpose is to help people conceptualize the vastness of deep time and how relatively short the history of multicellular life is.

A full suite of events are provided, including throughout the exceedingly long span of the Precambrian. It includes calculations for you to input the length of your walking path to find out how to space the boundaries.

If you adopt it for your events, you're encouraged to swap in more locally relevant prehistory. It has been held twice on a nature loop at a National Fossil Day event in Southern California with overall good feedback and success in the goal, and a few lessons learned. Patrons ranged from small children to lifelong learners. Dos and don'ts for adapting the tour for such a diverse group will be discussed.

Connecting Students to Citizen Science and Curated Collections

Presenter: **Erica Krimmel**

Collections-based university courses provide critical opportunities to introduce students to scientific techniques through hands-on learning. In this collaborative curriculum design project, we created a collections-based educational module that integrates traditional taxonomic practices, ongoing citizen science initiatives, and digital-age herbarium curatorial skills. Through this project, students produce archival-quality, research-ready plant collections that become part of our national biodiversity archive. Students are also introduced to essential information literacy concepts through their exposure to massive aggregated biodiversity datasets. Issues typically associated with student collections—such as poor quality specimens, a lack of data, or gross misidentification—are minimized by the workflow introduced in this project module (see diagram, right). Here, we present the initial findings of our survey-based course assessment, which demonstrate that this module contributes to effective systematic botany instruction.

Egghead: an Open Educational Resource (OER) card game

Presenter: **Cody J. Crawford**

Egghead is a free Open Educational Resource (OER) card game which teaches K-8 students about North American birds, their nests, and their eggs. The game consists of 40 beautifully illustrated cards--a male, female, nest, and set of eggs for 10 common bird species. The goal of the game is to arrange the cards into sets by species. At release, the game will be accompanied by resources to help educators incorporate Egghead into lessons about biodiversity, life cycles, organism-environment interactions, and other life science topics.

Undergraduate Experiential learning through Natural History Collections Course

Presenter: **Adania Flemming**

Museums serve extremely important roles in society, from research to education. University-based museums function as scientific institutions with the ability to provide undergraduate students opportunities to gain knowledge about the natural world and develop skills for future careers. During my tenure as a Master's student in the Biology Department at the University of Florida (UF) I created an Introduction to Natural History (INH) course. This course capitalized on UF's Florida Museum of Natural History to enrich the student academic experience. INH is an exploration of careers in museum-based research. During the course students are introduced to alternative career paths through observation of, and immersion, into the roles of museum collections personnel. Students' individual projects within the collections provided research and curatorial experience which contributes to advances in scientific knowledge. I have been accepted to the Biology Department at UF to conduct this research project as a Ph.D. student. Using formative and summative assessments as well as reflective exercises, my research project will evaluate the impact of the next generation of potential scientists and policy makers.

Those we hope to inspire to care about life and the integrated nature of earth systems! This academic experience aims to involve students in the process of learning in a meaningful way to encourage and enable them to become effective solvers of current and future natural-world problems.

The Society for the Preservation of Natural History Collections Conference provides a unique opportunity to present my research plans, preliminary findings, and solicit feedback. I would love to chat with you about similar experiences at your museum if they exist already and ways to create experiences if they do not. I would also appreciate your feedback on ways to improve this type of experience for both the students and collections personnel involved in the class.

Fossil Traveling Trunks

Presenter: **Polly Sturgeon**

We will present our loanable fossil-themed Discovery Trunk, which brings materials from our Education Collection to classrooms & informal educators. We will also present new trunk ideas for feedback.

Nature's Flying Machines

Presenter: **Blake C. Cahill**

Flying animals have a diversity of body forms and aerial abilities. They can teach us a lot about form and function. In fact, scientists study animal flight to develop flying robots, airplanes, and rocket ships. In this module, students explore the physics of flight and the adaptations that make powered flight possible.

The Science Hub

Presenter: **Aimee Davis and Susan Golland**

The Grainger Science Hub is a multi-function space that includes small exhibits, touchable elements, and educator facilitated hands-on activities. During specified hours, the space hosts a “meet a scientist” program where visitors can talk to museum scientists about their work. The Science Hub fosters critical thinking and the ability to explore like a scientist by using real objects as their starting point.

Special Interest Groups (SIG)

9:00am - 10:00am

Classrooms A, B and C and the Simpson Theater

Attendees can sign up to attend any or all of the SIGs listed at the Registration Desk. You may also create your own SIG during the conference just ask at the registration to have a sign up posted.

Carcinogens and Chemical Safety in Collections

Presenter: **Mickey Alice Kwapis**

Join taxidermist Mickey Alice Kwapis, of Chicago nonprofit the Specimen Museum, in learning how to avoid carcinogens and other hazardous chemical exposure while handling and restoring specimens within existing natural history collections. Additionally, attendees will receive

information on material safety during the preservation of new specimens. This Special Interest Group meeting will cover protocol for both new and existing dry study skins and skin mounts, fluid-preserved specimen collections, skeletal preparations, and invertebrate preservation through an exploration of wet and dry chemicals, the types of equipment that should always be available to workers, and safe storage once specimens have been prepared or restored. Time will be set aside for questions and answers following the program.

Please note that a portion of the presentation includes images and video of the restoration of 80-year-old human fetal remains which may be sensitive for some viewers; discretion is advised.

Science Through Story: Engaging Broad Audiences

Presenter: **Sara ElShafie**

Science is a search for evidence, but science communication is a search for meaning. Nothing makes content more meaningful than a good story. Drawing inspiration from creative processes in the film industry, this workshop offers tools to help museum scientists and collections professionals share their content with the public through effective storytelling. Using examples from both popular films and natural history museum collections, we will explore how to humanize a subject through story development and draw in broad audiences through visual storytelling. Throughout this hands-on workshop, participants will draft and share their own science stories for use in a context of their choosing. Everyone will leave with a treatment for a story, as well as a conceptual framework for future communication opportunities.

Collection Management Software Providers

Presenter: **Teresa Mayfield**

The Collections Management Software Special Interest Group is open to anyone who develops, manages, or uses specialized collection management software as well as those who aggregate data generated from these systems. We will begin a conversation regarding interoperability and data quality issues affecting all natural history collections.

Volunteers at the MfN – Future Prospects

Presenter: **Anja Friederichs**

With visitor numbers of up to 800,000 per year and round about 4200 Press releases/ 560 radio interviews/105 times on TV merely in 2018 about the museum as well as a financial blessing for the renovation and digitalization in the amount of 660 million euros the Museum für Naturkunde faces an increase in awareness and thus the requests to volunteer with us to get involved.

Volunteers give invaluable support to the Museum – in particular in the collections comprising 30 million precious items.

Classical fields of activity include:

- Sorting, stock-taking and labelling of collection items
- Entering data into databases
- Research and for specialists, work on certain groups or sub-collections in our scientific collections.

What do volunteers offer in addition to help? - special knowledge in different themes and networks?!

On the other hand, we would like to open the collection for the audience not only for special events or the long nights of museums. We would like to bring them in focus, turn our collections into a tangible experience for visitors and citizen scientists, preserve the internationally unique, valuable collections as national, cultural and global heritage for posterity, to further develop the collections as a modern information and research infrastructure and to make them digitally accessible worldwide.

We will need a lot of manpower for all these tasks and goals – our collection department – volunteers – internships – and of course hire a lot of qualified people.

Therefore, the question arises, how we get from an individual decision to a framework program for volunteers. How can you work with them, where you can find people with suitable skills, who cares about their care, contracts, working tasks have to set up, e.g.?

**Panel Discussion: Talking About Collections:
How to Share What You Do and Why It Matters**

10:00 am - 11:00 am

Simpson Theater

Aimee Davis, Volunteer and Public Learning Experiences Administrator, Field Museum

Kate Golembiewski, PR and Science Communications Manager, Field Museum

Katharine Uhrich, Social Media Manager, Field Museum

You know all kinds of amazing things about the collection you work with—how can you share all that information with the public? In this session, three of the Field Museum’s science communication experts will offer tips on making collections work engaging and accessible to the public through social media, in-person programming, and more. The talk will include a question and answer session so you can learn more about the topics that you’re most curious about.

Annual Business Meeting

11:15 to 12:15

Lunch

Kim and Carlos Chicago Style Hotdogs

12:15 to 1:25

Friday May 31st SPNHC Behind the Scenes Collections Tours

After Lunch, we will begin giving tours of our Collection Areas. To ensure a spot on your favorite collection tour please sign up for tours at the SPNHC registration desk. Sign up will be available throughout the conference or until all the tours are filled.

All tours will begin at the East Lobby Entrance on the Ground Floor.

Collection Research Center (CRC) Tours

Duration of each CRC tour is 1 hour and 30 minutes and is divided into 3 sections, with each section being ~25 minutes long plus ~5 minutes for travel time and restroom stops. We can accommodate a maximum of 180 people (12 groups of 15 people).

Zoology Tour 1

Starts at 1:30 goes to 3:00

Will Visit **Mammals (Rebecca Banasiak), Herps (Alan Resetar), and Fishes (Susan Mochel)**

Group A 15 people

Starts at Mammals at 1:30

Fishes at 2:00pm

Herps at 2:30

Group B 15 people

Starts at Fishes at 1:30

Herps at 2:00pm

Mammals at 2:30

Group C 15 people

Starts at Herps at 1:30

Mammals at 2:00pm

Fishes at 2:30

Zoology Tour 2

Starts at 3:00 goes to 4:30

Will Visit Mammals, Herps, and Fishes

Group G 15 people

Starts at Mammals at 3:00pm

Fishes at 3:30pm

Herps at 4:00pm

Group H 15 people

Starts at Fishes at 3:00pm

Herps at 3:30pm

Mammals at 4:00pm

Group I 15 people

Starts at Herps at 3:00pm

Mammals at 3:30pm

Fishes at 4:00pm

Geology & Anthropology Tour 1

Starts at 1:30 goes to 3:00

Will Visit **Oversize Anthropology (Jamie Kelly), Paleobotany (Ashley Klymiuk), and Vertebrate Paleontology (William Simpson)**

Group D 15 people

Starts at Oversize Anthropology at 1:30

Paleobotany at 2:00pm

Vertebrate Paleontology at 2:30

Group E 15 people

Starts at Paleobotany at 1:30

Vertebrate Paleontology at 2:00pm

Oversize Anthropology at 2:30

Group F 15 people

Starts at Vertebrate Paleontology at 1:30

Oversize Anthropology at 2:00pm

Paleobotany at 2:30

Geology & Anthropology Tour 2

Starts at 3:00 goes to 4:30

Will Visit Oversize Anthropology, Paleobotany, and Vertebrate Paleontology

Group J 15 people

Starts at Oversize Anthropology at

3:00pm

Paleobotany at 3:30pm

Vertebrate Paleontology at 4:00pm

Group K 15 people

Starts at Paleobotany at 3:00pm

Vertebrate Paleontology at 3:30pm

Oversize Anthropology at 4:00pm

Group L 15 people

Starts at Vertebrate Paleontology at

3:00pm Oversize Anthropology at

3:30pm

Paleobotany at 4:00pm

Friday May 31st SPNHC Collections Tours

Collection Tours Outside of CRC

All tours will meet and end at the Collection Tour Desk outside of CRC doors near the East Entrance.

Fossil Invertebrate (15 people max)

Paul Mayer

45 minutes each

40 minutes with 5 minute travel time

Tours starting at: 1:30, 2:15, 3:00, 3:45

Meteorites and Minerals (15 people max)

James Holstein

45 minutes each

40 minutes with 5 minute travel time

Tours starting at: 1:30, 2:15, 3:00, 3:45

Mammals (15 people max)

Adam Ferguson

45 minutes each

40 minutes with 5 minute travel time

Tours starting at: 1:30, 2:15, 3:00, 3:45

Anthropology Conservation

(15 people max)

Stephanie Hornbeck

45 minutes each

40 minutes with 5 minute travel time

Tours starting at: 1:30, 2:15, 3:00, 3:45

Flowering Plants (15 people max)

Christine Niezgoda

45 minutes each

40 minutes with 5 minute travel time

Tours starting at: 1:30 and 3:00

Economic Botany(15 people max)

Christine Niezgoda

45 minutes each

40 minutes with 5 minute travel time

Tours starting at: 2:15 and 3:45

Rare Book Room (10 people max)

Christine Giannoni

45 minutes each

40 minutes with 5 minute travel time

Tours starting at: 1:30, 2:15, 3:00, 3:45

Botany Imaging Lab (15 people max)

Daniel Le

30 minutes each

25 minute tour and 5 minute travel time

Tours starting at: 1:30, 2:00, 2:30, 3:00, 3:30, 4:00

Friday at the Field May 31st – Field Museum			
Time	Room	Title	Presenter
8:30	Lecture Hall 2	Education Share Fair	Molly Phillips
9:00	Lecture Hall 2	Education Share Fair	Molly Phillips
	Classrooms A, B, and C	Special Interest Groups (SIGS)	
9:30	Lecture Hall 2	Education Share Fair	Molly Phillips
	Classrooms A, B, and C	Special Interest Groups (SIGS)	
10:00	West Lobby	Coffee Break	
10:30	Simpson Theater	Talking to the Public Panel Discussion	Kate Golembiewski
11:00	Simpson Theater	Talking to the Public Panel Discussion	Kate Golembiewski
11:15	Simpson Theater	Talking to the Public Panel Discussion	Kate Golembiewski
11:30	Simpson Theater	Annual Business Meeting	Barbara Thiers
Noon	Simpson Theater	Annual Business Meeting	Barbara Thiers
12:30	West Lobby	Kim and Carlos Chicago Style Hot Dog Lunch	The Field Museum
1:00	West Lobby	Kim and Carlos Chicago Style Hot Dog Lunch	The Field Museum
1:30	CRC Doors	Collection Tours Start	Field Museum Collection Staff
2:00	CRC Doors	Collection Tours	Field Museum Collection Staff
2:30	CRC Doors	Collection Tours	Field Museum Collection Staff
3:00	CRC Doors	Collection Tours	Field Museum Collection Staff
3:30	CRC Doors	Collection Tours	Field Museum Collection Staff
4:00	CRC Doors	Collection Tours	Field Museum Collection Staff
4:30	CRC Doors	Collection Tours	Field Museum Collection Staff
5:00			
5:30	Vice Brewery	Informal Farewell	

Plenary Session

Kirk Wallace Johnson
*The Lessons of the Feather Thief
and the Tring Heist*

Kirk Wallace Johnson is the author of *The Feather Thief: Beauty, Obsession, and the Natural History Heist of the Century* and *To Be a Friend is Fatal: the Fight to Save the Iraqis America Left Behind*, which covers his work coordinating the reconstruction of Fallujah and his subsequent efforts on behalf of thousands of Iraqi refugees as the founder of the List Project to Resettle Iraqi Allies.

His writing has appeared in *The New Yorker*, the *New York Times*, the *Washington Post*, the *Los Angeles Times*, the *Wall Street Journal*, among others.

Johnson previously served in Iraq with the U.S. Agency for International Development in Baghdad and then Fallujah as the Agency's first coordinator for reconstruction in the war-torn city.

He is a Senior Fellow at the USC Annenberg Center on Communication Leadership and Policy, and the recipient of fellowships from the American Academy in Berlin, Yaddo, MacDowell, and the Wurlitzer Foundation. Prior to his work in Iraq, he conducted research on political Islamism as a Fulbright Scholar in Egypt. Johnson received his BA from the University of Chicago in 2002. Born in West Chicago, he lives with his wife and two children in Los Angeles.



Peggy MacNamara
On Collection(s) and Creation

Peggy is an associate professor at the School of the Art Institute. Peggy has been painting at the Field Museum for over 35 years. Her first published book *Painting Wildlife in Watercolor* with Watson-Guption in 2003.

Working with Field Museum scientists she then published four books with University of Chicago Press; *Illinois Insects* with Jim Boone and John Bates, *Architecture by Birds and Insects, The Art of Migration* with John Bates, and *The Return of the Peregrine* with Mary Hennen.

In 2018, she published a coloring book of museum species and a children's book, *Rosie the Tarantula*, a true story about a spider that got loose in the museum and her adventures in the collections and final return to Jim Louderman in the Insect Department.



Kyle Aaron Copas
Call for a Global alliance for Biodiversity Knowledge

Kyle Copas is a creative and communications professional whose work over the past two decades has focused on the intersection of sustainable design, conservation and biodiversity information.

Copas joined GBIF—the Global Biodiversity Information Facility—as a science writer in 2014, moving his wife, three teenagers and two dogs from Charlottesville to Copenhagen. He is now GBIF's communications manager, leading outreach and engagement with the GBIF network and its stakeholders while also contributing to the ongoing development and improvement of GBIF.org. He previously served in several roles with NatureServe, a biodiversity conservation non-profit based outside Washington, D.C., and as communications director for the pioneering architecture and sustainable planning consultancy, William McDonough + Partners.



Trained as a poet, writer and documentary filmmaker, Copas helped produce *World Peace and Other 4th-Grade Achievements*, an award-winning documentary by Chris Farina that profiles the work of master teacher and noted TED speaker John Hunter. He is a native of Lafayette, Indiana, and a graduate of Wabash College.

Abstract for plenary presentation is in the “Oral and Poster Presentation Abstracts” section.

Oral and Poster Presentation Abstracts

Presenters' last names and emails are in bold.

Specimen Spotlight titles and authors are in a separate section following the Author Index.

Getting the Hang of It: Storage and Display Improvements for Suspended Vertebrate Specimens at the Michigan State University Museum

Laura M. **Abraczinskas**¹, Amanda J. Brohman², and Barbara L. Lundrigan¹

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GS-02 General Session Poster Presentations

Established in 1857, the Michigan State University (MSU) Museum houses natural science collections that include 117,000 research and teaching specimens of preserved vertebrates. These collections are worldwide in scope and provide a record of biodiversity that ranges from 1844 to the present day. Many of the specimens, including articulated marine mammal skeletons and several taxidermy-mounted birds, bats, and fish, were fitted long ago with suspension hardware and attachments to facilitate hanging them for display or storage. One specimen, an articulated skeleton of an African Bush Elephant (*Loxodonta africana*), was mounted using suspension hardware that connects to metal rails on the ceiling and functions to provide structural support. In 2017, a deformation in the elephant rail component necessitated an immediate structural assessment and subsequent changes to that support system. This repair prompted an assessment of all suspended specimens, and

initiated a series of housing and display improvements. It was determined that many of the hanging specimens were suspended using non-archival materials or materials of unknown age and composition, and in many instances the hardware and components showed visible signs of deterioration. These problems were addressed by 1) specimen-specific assessments based on review of materials, suspension requirements, and schedule of use; 2) targeted replacement of suspension materials and systems; 3) and revision of associated policies, operational procedures and documentation, including inspection schedules and condition reporting. These improvements have stabilized the suspended specimens and assure periodic reevaluation, in accordance with the MSU Museum's commitment to ensure preservation of, and safe access to, the vertebrate collections.
Keywords: suspended specimens, hanging skeletons, storage and display improvements
<https://osf.io/b462k/>

Workflows for Sampling Museum Specimens and Cataloging Genetic Samples

Katie F. **Ahlfeld**¹, Lisa M. Comer¹, Mark P. Lehtonen², and William E. Moser¹

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GS-02 General Session Poster Presentations

Emerging technologies and advancements in genomic research have significantly expanded the traditional use of the Smithsonian Institution, National Museum of Natural History, Department of Invertebrate Zoology's (NMNH-IZ) collections. Increasing visitor activity and loan requests for genetic material mean that NMNH-IZ receives and processes more frozen collections of tissues and DNA extractions than ever before. In partnership with the Global Genome Initiative (GGI), the Department of Invertebrate Zoology has developed workflows to make these samples available to researchers through the Global Genome Biodiversity Network (GGBN) and to consistently track their usage and avoid oversampling of rare and significant specimens. Though not intended as a comprehensive guide to collection management best practices, these workflows provide a solid framework for the efficient processing of genetic samples from field to lab to archival collections. *Keywords:* Invertebrate, Sampling, Workflows, Genetic Resources
<https://osf.io/ga3sq/>

‘Snapshots in Time’ – Leveraging Natural History Collections to Inform and Communicate Science: A Case Study Featuring African Leopards (*Panthera pardus*) and Wolves (*Canis lupus*) of the Greater Yellowstone Ecosystem.

Corey A. Anco

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GS-01 General Session Oral Presentations

Natural history museums (museums) maintain repositories of specimens, often in the form of skulls, skins, and skeletons. As environments change, species either adapt and survive or

perish. In instances where an organism or historic population of a species is no longer found, curated specimens in museum collections may become the only physical record of a species' occurrence. Museum collections represent historical snapshots enabling researchers to investigate and compare extant and extinct species and populations. Case #1: Once found throughout Africa and Eurasia, the leopard (*Panthera pardus*) has disappeared from much of its former range. Historically, more than 50% of the leopard's global range occurred in continental Africa, yet sampling from this part of the species' distribution is only sparsely represented in prior studies examining patterns of genetic variation at the continental or global level. Research supports the theory that wide ranging species exhibiting discontinuity within their range may also exhibit variation at the molecular level; variation tends to correspond to geographic regions and major climatic events. Using leopard specimens (skulls) from the American Museum of Natural History collections, along with field samples, and published sequences we identified previously unrecognized genetic diversity in African leopards and provide a reference benchmark of diversity against which future monitoring can be compared. These findings emphasize the utility of historical museum collections in understanding processes that shape present biodiversity. Case #2: The Draper Natural History Museum (Draper) is the only major repository in the Intermountain West dedicated to acquiring and maintaining scientific collections, especially higher vertebrates, representing the biodiversity of the Greater Yellowstone Ecosystem (GYE). Like the leopard, the gray wolf (*Canis lupus*) has one of the largest historical distributions of any terrestrial mammal. A common question received by visitors to the Draper is whether reintroduced wolves are significantly larger than

the historic population of wolves that inhabited the GYE. In this ongoing study, we are examining wolf specimens (skulls) found in museum collections to quantify whether wolves representing pre-extirpated populations present in the GYE during the early 20th century are significantly smaller in size than the skulls of wolves representing the reintroduced GYE population of wolves.

Keywords: Museum Specimens, African Leopard, Gray Wolf, Phylogeography, Morphometry
<https://osf.io/s7ck5/>

Don't Touch the Pretty Ones: Destructive Sampling Protocols in the Canadian Museum of Nature's Mineral Collection

Erika B. **Anderson**

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SY-14 Best Practices in Destructive Sampling: Methods for Limiting Specimen Information Loss While Maximizing Research Potential

Mineral specimens often have a higher monetary value than other natural history collections, leading to different considerations when it comes to sampling a specimen. Destructive sampling may be required for analyses by x-ray diffraction, electron microprobe, scanning electron microscopy, isotopic analyses, and many other techniques essential for mineralogical research. Aesthetic specimens are often considered works of natural art, and the detrimental effects of sampling must be carefully weighed against potential scientific gains. The Canadian Museum of Nature follows the category system outlined by J.D. Price and G.R. Fitzgerald's "Categories of Specimens: A Collection Management Tool" in *Collection Forum* Volume 12 (1996). Many considerations, including analysis type, value of the specimen, specimen nature, must be taken into account

when sampling mineral specimens. For example, one large terminated crystal is much harder to sample than a series of small crystals, as large undamaged terminated crystals are prized and separating off a piece would be far more noticeable. One method of alleviating destructive sampling pressure from the more aesthetic specimens is to sample from lower quality material. The Canadian Museum of Nature has a separate collection of lower aesthetic quality minerals that are more easily sampled. Many of these specimens were collected by staff, from regions throughout Canada, in support of their research programs. However, as mineral values continue to climb, even these specimens could quickly gain monetary value. In addition to methods of sampling, the retention of produced data and subsamples is imperative, as these can be reused, minimizing the need for destructive sampling in the future. I will cover Canadian Museum of Nature destructive sampling protocols using examples from the National Mineral Collection.

Keywords: Minerals, Destructive Sampling, Geology
<https://osf.io/5htvy/>

CM Risk Assessment Project 2019 - A Progress Report

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GS-02 General Session Poster Presentations

In 2017, Carnegie Museum of Natural History (CM) received funding from the Institute for Museum and Library Services (IMLS) to conduct a risk assessment for its collections. CM

had already conducted two general conservation surveys (1989 and 2010) and an environmental survey (2011), all funded by IMLS. The next logical step was to conduct a risk assessment.

It was important that both administration and staff supported both the concept and the process. Initial planning was part of the IMLS grant application process, including consultation with R. R. Waller, Protect Heritage Inc., an experienced subject matter expert. Waller has a longstanding relationship with CM, having been part of the core team during the 1989 and 2010 surveys. Additionally, the grant application proposed the use of Waller's Cultural Property Risk Analysis Model (CPRAM) to assess our risks.

We recognized from the start, that staff time was limited and therefore included funding for a full-time collections associate dedicated to the project. Having this "gatekeeper" to manage the data keeps the project focused, responses consistent, and maximizes scheduling.

The overall goal of the project is to identify risks to the collections in a quantifiable manner by completing a workbook that documents hazards in each collection unit at CM. The risk assessment workbook links data to the CPRAM. Using these data, we will prioritize those identified risks and subsequently develop reasonable strategies to reduce them. This project will inform the overall strategic plan currently being developed for CM. By including a few non-collection staff, the risk assessment also will promote better understanding and communication of collection concerns across the museum and our parent organization.

Our biggest challenges have been to coordinate staff according to the original schedule and ensure that the gatekeeper understands the CPRAM and the agents of deterioration. The gatekeeper must then apply the data to the

workbooks in a meaningful way. The initial workbook took significantly longer to complete, necessitating scheduling adjustments and re-evaluation of roles.

This poster examines our progress in the two-year project. It takes a critical look at our successes, challenges, and plans to complete this complex project on schedule and within budget.

Keywords: Risk Assessment, Strategic Planning, Collection Care

<https://osf.io/5psqy/>

Shelf Liners for Fluid Collections

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SY-10 Storage Techniques For Art, Science, And History Collections (STASH) Preventive Conservation And Storage: STASH Flash II

In 2016 the Carnegie Museum of Natural History received National Foundation of Science funding to optimize the fluid collections managed by the museum's Section of Amphibians and Reptiles. The Section is notable for its world-class collection of ca. 235,000 specimens, ranking tenth among US collections of its kind. The majority of the collection is housed in a 1907 National Historic Registry structure known as the Alcohol House, which was built as part of Carnegie Institute, to house the museum's fluid collections. Spanning more than 100 years of scientific collecting in 170 countries, the collection includes: 148 holotypes and 2,007 paratypes (representing 353 nominal taxa), specimens of five extinct and 78 critically endangered species, and one of the world's largest turtle collections.

The Alcohol House has changed little since construction. One major goal of the project is to reorganize the herpetology collection, update the

taxonomy, provide an improved storage environment and improve accessibility, while maintaining the historic nature of the building.

This paper will address one aspect of the project. Shelving units on the upper two floors of the building are original to the structure. They were built-in, back to back narrow shelves. There is a 6" gap between the backs of the shelves. Jars were seriously overcrowded. Smaller jars could easily be lost through these gaps. The curator, collection manager and conservator determined that a 55% increase in shelf space would be gained if shelving units could be optimized.

Shelf liners were designed to maximize use of the shelves and improve safety for the jars. The following talk will detail the design and process.

Keywords: Shelving, Storage Furniture, Fluid
<https://osf.io/tyx93/>

OGL's Marine DNA Bank: Important Applications to Conservation and Seafood Security

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SY-13 SCNet Symposium: No Collection Left Behind: Research Contributions of Small Collections

Ocean Genome Legacy (OGL) is a non-profit marine research organization and biological specimen repository dedicated to exploring and preserving the wealth of information contained in the genes (DNA) of endangered, rare, unusual, and ecologically critical marine organisms. Our mission is to acquire, authenticate, study, preserve, develop, and distribute genetic materials, biological specimens, information, technology, and standards needed to advance

basic and applied non-commercial research. By providing secure storage, broad public access to genomic materials and a forum for sharing samples, data, and ideas, the OGL collection aims to serve as a catalyst for research that can help to protect marine ecosystems and improve the human condition. OGL acquires DNA-containing tissue and/or blood samples from marine organisms through collaborations with academic researchers, museums, aquariums, and other marine science groups. Our collection now contains more than 27,000 genomic samples of marine animals, plants, fungi and bacteria. These samples have been used for the development of seafood reference materials that are critical for the maintenance of sustainable fisheries, detection of genetically modified salmon, increased understanding of unusual animals like narwhals, and the conservation of protected species, such as black corals.

Keywords: Genome Biorepository, Marine organisms, DNA
<https://osf.io/s7up3/>

Making a Large Impact on a Small Herbarium: The Impacts of an NSF CSBR Grant on a Regional Herbarium

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GS-02 General Session Poster Presentations

Regional herbaria are known for their value in holding the best representation of their respective local floras; however, they often operate without an annual budget, generating massive backlogs and hindering the impact that they could otherwise make. Such was the case with the

Georgia Southern University Herbarium (GAS), in which over half of its collection was unmounted, unaccessioned, and unavailable for research and teaching. Through a National Science Foundation Collections in Support of Biological Research Grant, GAS has experienced substantial changes in its ability to curate and protect specimens. More importantly, our herbarium has also increased holdings of accessioned materials. Over the last three years, the collection has grown from 21,127 to 43,143 specimens, with numerous specimens continuing to be processed on a daily basis. The collection's regional focus remains in the Georgia Coastal Plain, one of the most understudied yet biologically diverse ecosystems in Georgia. The grant further provided opportunities to update the nomenclature, replace deteriorating folders with archival-quality folders arranged geographically, and better engage students and the public through teaching modules. Digital images and data of the specimens have also been made widely available and searchable through the SERNEC portal (<http://sernecportal.org/portal/>). <https://osf.io/dshjn/>

Materials Selection & Specification Working Group: A New Initiative of the AIC Collection Care Network

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SY-10 Storage Techniques For Art, Science, And History Collections (STASH) Preventive Conservation And Storage: STASH Flash II

Storage, transit, and exhibit materials influence the long-term stability of museum collections and specimens; the selection of appropriate materials is often fraught challenges. At the June 2017 annual meeting of the Society for the Preservation of Natural History Collections (SPNHC) in Denver, Colorado a group of conservators informally engaged in a conversation related to the challenges in effectively selecting materials for collections storage, transport, and exhibit, sparking the idea for a Materials Selection & Specifications Working Group (MWG). From this initial conversation to sustained email discussions over the coming months, it became clear that engaging a larger, formal group of professionals (ranging from scientists to conservators and collection managers, and from exhibit designers and fabricators to manufacturers and vendors) is critical to create understanding and define the challenges related to materials selection and to establish a platform which can be used to facilitate information exchange.

Since the initial discussions, the MWG has been formalized as a new initiative of the AIC Collection Care Network and held two in-person meetings that have brought together a group of stakeholders from a wide range of allied fields and interests to develop a basic framework for producing a means to exchange information within the collections care community. This presentation will focus on the MWG development, goals, work to date, and how SPNHC members can get involved.

Keywords: materials, storage, conservation
<https://osf.io/smweh/>

Northern Museum of Zoology: Reinvigorating a Resource for Enriching Undergraduate Education

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GS-02 General Session Poster Presentations

The Northern Museum of Zoology (NMZ) was established in 1974 as a teaching resource for the Department of Biology at Northern Michigan University, a mid-sized public institution in Michigan's Upper Peninsula that is primarily focused on undergraduate education. In 2012, faculty and students initiated a process of transformation in the museum, with the goal of enhancing and extending its role in the university's educational mission. Here we report on primary strategies employed for reinvigorating the museum, as well as key outcomes for both the museum and students. Critical elements of museum transformation included: cultivating departmental support through faculty engagement, establishing an online database (Arctos) to facilitate both collection management and data dissemination, and developing resources and procedures to create an efficient pipeline for specimen preparation and installation. Efforts to increase visibility within the university and the broader community, collaboration with specimen-based research programs, and engagement with state and federal wildlife agency personnel have led to growth of the museum, particularly in the mammal collection. Collection growth has fostered undergraduate interest and engagement, and created diverse opportunities for students to participate in curation and in independent specimen-based research. Since this transformation began, roughly 100 students have participated directly in collections-related activities. Student enthusiasm has been harnessed to pursue new initiatives such as upgrading and digitizing existing collections (e.g., herpetological collection) and establishing

new collections (e.g., parasite collection). The impact of these efforts is compounded via linkages to the global research community through the online database, which allows students to see the results of their contributions through specimen query statistics and loans. The revival of the NMZ demonstrates how small to mid-sized institutions that house natural history collections can reap benefits by breathing new life into their old collections.

Keywords: education, Arctos, undergraduate
<https://osf.io/kycn7/>

Improved Specimen Preservation through Digitization at Canada's National Collection of Vascular Plants

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GS-02 General Session Poster Presentations

Agriculture and Agri-Food Canada (AAFC) has been collecting, preserving, and facilitating access to vascular plant specimens for over a century to support research, agricultural policy, and regulations. The National Collection of Vascular Plants (DAO) now consists of over 1.5 million specimens, making it Canada's largest herbarium.

BioMob (Mobilization of Biological Collections) is an initiative that is investing \$10 million over six years to accelerate data capture and imaging of specimens held in AAFC's biological collections. The mobilization of these open data will improve access to the collections and further support research, policy, regulation, and enforcement. The complete digitization of the DAO collection assists curatorial staff in identifying and addressing taxonomic and

geographic gaps in the collections, with particular attention paid to plant groups linked to invasive alien species and species beneficial to Canadian agriculture.

A less obvious, but significant, benefit is improved curatorial capacity to address the DAO collection's long-term preservation needs. In BioMob's vascular plant digitization workflow, every DAO specimen is handled by digitization staff. This process allows staff to flag specimens in need of preservation treatment. Preservation issues range from the use of improper mounting materials to insect damage.

This level of specimen handling as a concerted effort has never occurred at DAO. The BioMob digitization workflow presents an exceptional opportunity to identify and address several outstanding preservation issues. This process improves specimen quality and ensures that the research utility of the collection will be maintained in perpetuity.

Keywords: Preservation, specimen quality, digitization, workflows
<https://osf.io/tk3g7/>

Testing the Effect of Denatured Alcohol on the Preservation of Zoological Wet Collections

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GS-02 General Session Poster Presentations

The Museum für Naturkunde Berlin, Germany (MfN) comprise important collections with about 30 million objects of historic and recently collected material from all over the world.

Large quantities, i.e. 1 million lots/objects are fluid preserved and stored in about 300 000 jars.

When it comes to the preservation of wet collections the use of non-denatured alcohol is widely recommended. However, in many European collections denatured alcohol is still commonly used due to the restricted availability of pure ethanol caused by taxation.

Published results and research concerning the influence of denaturants on the integrity of fluid preserved natural history specimens and their containers are scarce and observations on the effects of using denatured alcohol over longer time periods are usually anecdotal.

Therefore, the MfN is planning to set up a long-term study to compare the effects of different denaturants, most commonly used in the preservation of wet specimens.

We want to examine the possible consequences of denaturants both on the external appearance of wet specimen as well as on their molecular integrity, i.e. the effects on DNA and stable isotopes over the course of the next 20 years.
Keywords: fluid preservation, denaturants, ethanol
<https://osf.io/8tvbz/>

Developments on Rehousing the Ethanol Collections at the Academy of Natural Sciences of Drexel University

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GS-02 General Session Poster Presentations

Founded in 1812, the Academy has the oldest mollusk collection in North America. In 2014, the Academy's Malacology Department secured National Science foundation funding to rehouse its molluscan fluid-preserved collection. This collection consists of 41,000 cataloged lots, which contain 1.5 million specimens from about

140 countries. Many samples had not been rehoused since first catalogued, and an increasing number of lids were failing, which threatened the integrity of the collection. We redesigned a database that had been used for recording maintenance activity for our alcohol collection to link to our main collection database by catalogue number and show potentially matching records from the current and prior number fields. More than 50,000 lots have been processed to date. Most lots have had the lids replaced and almost 22,800 have had the container replaced, many moving from 2-ounce jars to 6-dram vials to save space. 6,800 lots had fluid level under 50% and 1,123 were desiccated. So far, 415 lots (0.83%) have not had matching database records. These were effectively lots lost in the collection since without a database record we did not know we had them and there was no way to find them short of the full inventory funded by the project. Jars and vials are placed in modular trays, which can be easily removed from the shelf to check fluid levels. Shelving units are rebuilt to decrease the space between shelves, since headroom for removing individual jars is no longer needed with the modular tray design. This has resulted in 20% expansion space for the collection, even though we no longer use the top shelves of the units, to avoid the need to use ladders, and the bottom shelves are only partially filled, now being reserved for oversized jars.

<https://osf.io/r976k/>

Collecting Memories: Using Natural History Collections to Connect Vulnerable Adults with Memory and Cognitive Enrichment

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GS-01 General Session Oral Presentations

Our elderly deal with loss at many levels. Loss of home, loss as a result of physical and mental disabilities such as loss of hearing, eyesight, memory recollection, mobility, and other physical functions. Due to these and other limitations long-term care residents are unable to leave a facility for long periods of time making a visit to a museum often difficult. A pilot program called Collecting Memories brings natural history collections to the institutionalized vulnerable aimed at connecting the elderly with memory, enrichment, and the natural world.

Cognitive engagement and creativity can be the precursor to critical thinking and empowerment which are skills not generally promoted in this target population. This creative aging pilot program engages residents with the natural world through sensory and cognitive-based engagement whether it is classification of shells, observation skills as they discover variations of species, learn photography, or create paper relief specimens. Through the art of photography, residents engage in interpretive narratives and contribute to a collaborative exhibit featuring the diversity of life both seen and unseen.

The natural world is a universal language and can bridge cognitive, social, physical, and language barriers reconnecting institutionalized residents with a world they are largely disconnected with. This presentation will share the results of our first pilot program and introduce how natural history collections can be used to serve societal needs while crossing boundaries between science and the public, science and art, and object and memory.

Bios

Dr. Anne Basham has worked for the past six years as Education/Outreach coordinator at the Arizona State University Natural History Collections. She obtained her doctorate in Education Leadership and Innovation with research in the natural sciences and geragogy (pedagogy for older learners). Anne also has five years of experience working in both assisted and skilled nursing facilities as an Enrichment Coordinator and as a lifelong learning consultant.

Laura K. Ontiveros is Enrichment Coordinator at Fellowship Square in Historic Mesa, Arizona. Laura has a Masters in Public Administration from Grand Canyon University with an interest in innovative lifelong learning programs.
Keywords: Outreach, natural history collections, creative aging, lifelong learning
<https://osf.io/cusjv/>

Libraries of Life: Connecting Audiences with Natural History Collections Via Augmented Reality

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GS-02 General Session Poster Presentations

As museums start to think outside of the proverbial collection box, augmented reality and computer vision technologies may well be the tool of choice in moving experiences beyond the physical object while facilitating deeper engagement and accessibility. With this, new best practices and communities of practice will

arise along with the need to answer new questions.

- To what degree can virtual objects take the place of physical objects?
- What role and impact might new immersive technologies have in cognition and learning?
- How might this technology motivate social change and promote public awareness as to the importance of natural history collections?

While the landscape of emerging technologies unfolds, there is perhaps no better time to explore how these technologies might democratize the museum and move us beyond the collection box. To pursue the potential uses of augmented reality for natural history collections in the classroom, ExplorMor Labs has released a new version of the app to be more user friendly to teachers while continuing to serve as a collaborative platform representing the collections and message of natural history museums, government agencies, and conservation and environmental groups. This Demo session will introduce the new online platform and app interface while providing an opportunity for everyone to try the app on their own devices with take-away AR cards.
Keywords: Emerging technologies, mobile app, augmented reality, natural history collections
<https://osf.io/2d7bs/>

Avian Pediatrics: Why Eggs and Small Collections Can Be an Essential Scientific Resource Now and into the Future.

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SY-13 SCNet Symposium: No Collection Left Behind: Research Contributions of Small Collections

Eggs represent an essential aspect of the avian life cycle, and they have fascinated naturalists and collectors since the 1880s. They also have been used in seminal research into the effects of pesticide use and more recently for documenting the impacts of climate change. There are approximately 5 million eggs in avian collections scattered across the globe. Many of these are in small collections and many are undigitized. I discuss the value that small collections have played and can play in the future for ornithological research, as well as ways in which small collections might consider building and archiving local data that can be used in long-term monitoring and research.

<https://osf.io/rs8fk/>

Digitally Vouchered Specimens in the myFOSSIL eMuseum

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SY-13 SCNet Symposium: No Collection Left Behind: Research Contributions of Small Collections

The FOSSIL Project is an NSF-funded initiative to create a social paleontology community and promote collaborations between educators, interested parties, and professional and amateur paleontologists. A feature of the myFOSSIL web platform is the ability to upload your personal fossil collection. This fosters discussions on identification, localities, photography, and much more. As the last large effort for the project, we have developed an eMuseum with specimen data curated following Darwin Core standards through the development of a custom WordPress plugin. We will work to make this plugin

available so that anyone interested in curating a personal collection on their WordPress site will have access to its capabilities.

The vision for the eMuseum is to promote and facilitate public participation in scientific research through allowing personal fossil specimens to become vouchered museum specimens publicly available through data aggregators. In order to do this we have developed a workflow with three volunteer assistant curators with two-year terms that will aid in curation of site specimens. The curation team will evaluate data associated with specimen occurrences and determine ‘research’ and ‘casual’ grade specimens. This team will also facilitate digital rotating exhibits created by specimens on the myFOSSIL portal. Research grade specimens will be exported to iDigBio on a regular basis as the myFOSSIL platform is a dynamic and growing platform.

<https://osf.io/dk782/>

The International Specify Collections Consortium

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GS-01 General Session Oral Presentations

In 2018, the Specify Software Project transitioned into the Specify Collections Consortium, a not-for-profit organization dedicated to advancing the impact and broader engagement of biological collections through collaboration on open-source, informatics tools for research, education, and outreach. The Consortium is international and self-funded with tiered levels of institutional membership. It has secured annual membership commitments from

69 collections institutions, including four Founding Members, U. Michigan, U. Florida, U. Kansas, and the National Natural History Museums of Denmark. In partnerships with the South African National Biodiversity Institute and the Geneva Natural History Museum, with a significant collection base in the U.S., Canada, Brazil, and Australia, and with increased interest from biological collections in Europe and Russia, Specify Collections Consortium members have an opportunity to innovate and sustain collections computational infrastructure on a global scale.

The comprehensive Specify database design and its flexible user-interface customization capabilities make Specify's workstation and web platforms easily customized to meet the needs of legacy museum workflows for specimen transactions and data processing, as well as to match the requirements for modern, standards-compliant, best practices software for future compatibility with analysis services.

Our application programming interfaces (API), data source linking, and highly-configurable export functions for sending data to aggregators and other portals will continue to expand as we work with members to set priorities for new-plugin capabilities, support for advanced data types and integration, and on opportunities to increase museums' return on investment in specimen digitization.

In this talk, we will report on recent Specify Collection Consortium activities, new and planned capabilities, our technical and hosting services, and present examples of how the Consortium is able to support collections computing in museums of all sizes and technical staff levels.

Keywords: Software, Databases, Consortium, Informatics, Museums
<https://osf.io/btshml>

Digitization and the Contribution of Small Natural History Collections in Global Change Biology

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SY-13 SCNet Symposium: No Collection Left Behind:
Research Contributions of Small Collections

Although small natural history collections can host a wealth of data with particular taxonomic, ecological or geographic strengths, these data were historically underused in research utilizing biological specimens. Advances in information technology combined with the global institutional investment to digitize biological specimens and their associated data is providing an opportunity for data from small natural history collections to be used more frequently in scientific research. Here, I examine the usage of small collections (<100,000 specimens) in global change research prior to and after widespread digitization efforts. To obtain the studies used in this analysis, I reviewed all studies that were cited in articles published in the November 2018 *Philosophical Transactions of the Royal Society B*'s themed issue: "Biological Collections for Understanding Biodiversity in the Anthropocene". I then examined the abstract and/or title of each article, eliminating those that were not related to global change. Articles were also eliminated if a complete list of what collections were used to gather the data was not provided. In this presentation, I will present results of how the relative usage of small collections in global change biology has changed overtime and explore potential spatial biases regarding where these small and large collections are located. Preliminary results suggests that the percentage of studies using data from small natural history collections has increased in recent

years. Small collections are rich resources for specimens representing intense regional, temporal, community and taxonomic sampling. Digitization efforts must continue to occur at both large and small collections to ensure these data resources are becoming available to the research community. Once available and standardized through online aggregators, these data are being used by researchers.

Keywords: Digitization, Global change biology, Natural history collections
<https://osf.io/f85vc/>

Connecting with the Modern Maya: The Chiapas Digitization Project

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GS-01 General Session Oral Presentations

Although heavily documented in print and images through the Harvard Chiapas Project 1957-1980, material culture collections of the Highland Maya of Chiapas have not been fully documented or readily accessible to local or worldwide communities.

Collections and archives from the Highland Maya of Chiapas are scattered worldwide. The Chiapas Digitization Project (CDP) will create a virtual archive of objects, images, recordings, and written records to document a rapidly changing culture.

This archive will not only make the catalogs accessible but present the information in a way that is useful to multiple audiences. The Chiapas Digitization Project (CDP) is a collaboration of anthropologists, weavers, indigenous artists, researchers, writers, and museum curators.

Phase 1 is a pilot project using the partially completed digital catalog from Museo Na Bolom

in San Cristobal de Las Casas. A small team will standardize the data and lexicon, integrate field notes and update photographs from a portion of the textile collection to create a searchable database. The data will then be used to experiment with different presentation styles. A group of weavers and indigenous artists will be chosen to test and critique the various forms.

The project will be expanded to other collections after determining the format and methods most useful to the communities and collections-holders. Additional collections and collaborators will be added as the project continues.

Challenges facing the project in Mexico include the lack of infrastructure and equipment, the need for technical support, need for funding, lack of standardized data fields and lexicon, and language barriers. All are currently being addressed. The catalog, or at least the presentation form, will be in multiple languages; Spanish, English, and Tzotzil.

The coordinating committee is currently investigating funding sources and infrastructure options for the U.S. base of the project. The pilot will begin the summer of 2019 and the follow-up project will begin the winter of 2019.

Keywords: Maya, digitization, material culture, collaboration, textiles
<https://osf.io/32b6z/>

Opening up the Collection of MfN

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SY-05 Managing And Digitizing Large Collections

The Berlin Museum of Natural History (MfN) was granted substantial funding for building a state-of-the-art research and information

infrastructure, an open and integrated research museum. This provides a unique opportunity to create excellent conditions for preserving and opening up the museum's collections. Specimen information resulting from more than two centuries of research is partially locked in handwritten documentation and in the storage systematic. Making this information accessible consequently implies to make the collection available at specimen level. While physical access may be hampered by storage conditions and handling restrictions in terms of conservation, digital access is still impossible for the major part of the collection because of insufficient digital cataloguing. A recent survey among Germany's largest collections revealed that only a little more than 5% of 120 million objects are represented in online available catalogues. From this follows that the logical first step to tackle the challenge of opening up the whole collection has to focus on making legacy specimen data digitally available. This presentation will discuss the choices taken at the Museum für Naturkunde in planning the allocation of the available funds in collection development and digitization. As the project is still in an early phase, the proposed talk will explicitly present ideas and choices rather than solutions. For example, the necessary tasks toward reaching the goal of a full collection disclosure have been identified through a structured internal survey. This survey focused on digitization processes and handling characteristics rather than collection units. The resulting antagonism of identical digitization processes in completely different taxonomic units turned out to be a challenge in terms of planning the logistical implementation of the digitization. In order to test a variety of digitization processes and in order to optimize related workflows, a test lab will be set up in the exhibition area of the museum. At the same time, this will allow to develop a concept for

communicating the process of disclosing a natural history collection and to create a touchpoint for public interaction. Furthermore, societal stakeholder thus will be able to participate and to help shaping the process.

Keywords: Digitization, open up collections, metadata, stakeholder involvement
<https://osf.io/pvmns/>

Demo Camp: New Approaches to Volunteer Training in Specimen Preparation

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GS-01 General Session Oral Presentations

The Herbarium at Rancho Santa Ana Botanic Garden is comprised of the RSA and Pomona College (POM) collections and holds over 1.2 million specimens, making it the 3rd largest herbarium in California. RSA-POM processes ~14,000 specimens annually, and are primarily mounted by a large team of volunteers. Because of frequent staff and volunteer turnover, there has been a lack in consistency in retaining and maintaining a standardized method for specimen preparation. An attempt to rectify this issue included holding enrichment sessions for volunteers every 6 months, which proved to be ineffective due to sporadic volunteer attendance and the nature of mostly passive learning through PowerPoint presentations. Recently, a new approach to volunteer training implements monthly 15-20 minute "Demo Camps" in which one topic in specimen preparation and best practice approaches is taught. Demo Camps frequently cover preparation of challenging specimens, such as cacti, grasses, and bulky specimens. This method of hands on demonstration has created a dynamic and interactive teaching environment to more

effectively engage volunteers. Further, each Demo Camp produces a standardized written protocol that can be referenced by current volunteers and used for training new volunteers, staff, and interns. Volunteers are also encouraged to request topics for future Demo Camps, which has notably increased participation.

Implementation of monthly Demo Camps has improved volunteer communication, efficiency, and specimen quality while instilling a greater appreciation of the value of the collections they are working with.

Keywords: Volunteers, demo camp, specimen quality, efficiency
<https://osf.io/m45pz/>

BRIT Digitization Appliance

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DC-01 DemoCamp

The natural history collections community continues to increase the rate of collection digitization and specimen data mobilization. This increased rate of digitization can be attributed in part to innovative improvements in workflows. However, a common workflow bottleneck often occurs in that period immediately following image capture but preceding image submission to portals, a critical phase involving quality control, file management, image processing, metadata capture, and monitoring of performance.

While larger institutions have likely developed reliable, automated workflows, small and medium institutions may not have the expertise or resources to implement workflows that take full advantage of automation opportunities. Without automation, these institutions must

invest many hours of manual effort to meet quality and performance goals.

To address its own needs, BRIT developed a number of workflow automation components, these coalescing over time into a suite of tools which operate on both an image capture station as a client application and on a server which provides file storage and image processing features. Together, these tools were created to meet the following goals:

- Simplify file management and data preservation through automation
- Quickly identify quality issues
- Quickly capture skeletal metadata to facilitate later databasing
- Reduce time between image capture and online availability
- Provide performance and quality monitoring and reporting

The client and server components together can be considered a “digitization appliance”: software integrated with the specific goal of providing a suite of tools that can be easily deployed on simple hardware to provide a comprehensive set of digitization functions. This presentation will provide an overview of the BRIT digitization appliance and improvements that have been made over the past year. This software is available under an open-source license at

https://github.com/BRITorg/digitization_appliance

Keywords: digitization, workflow, software
<https://osf.io/fk7j8/>

Telling the History of Monterey through Herbarium Collections

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GS-02 General Session Poster Presentations

The history of Monterey is deeply entwined with its marine resources. While this includes a varied number of species from tiny plankton, silver sardines, and even the largest of whales, there is an often-overlooked organism that is incredibly important to the bay: Seaweed. Seaweed, or algal, herbariums offer a unique opportunity to explore both biodiversity and the stories of the naturalists, ecologists, and students who helped shape the Monterey Bay community. Herbaria have long been used by students and researchers to document and learn about the environment through a botanical lens by producing pressed plants or algae that can then be studied and referenced out of the field. The ease with which these attractive collections can be produced also allows hobbyists and naturalists to produce beautiful and accurate specimens. Examining the metadata of multiple herbariums through time and investigating the contributors to these collections presents a new way of looking at the history of the people and ecology of Monterey. The hidden stories herbariums can tell provides an argument for the importance of their preservation and the continued need for accurate scientific collections.

Keywords: Herbarium, Marine Resources, Algae, Seaweed

<https://osf.io/9be3q/>

Data Licenses, Waivers, and Publication: the Creative Commons and How to Share Your Data for the Greatest Good

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SY-02 Licensing And Rights Around Collections Data And Media

In 2014, GBIF began a two-year process to apply standardized licences to every published data set to give data users and publishers greater clarity and to enable them to work confidently with knowledge of the terms of use for data accessed through the GBIF network. To implement this policy a large-scale communications and educational effort was implemented to bring every collection into compliance. This presentation will explore the licenses and waivers applied by GBIF and the rationale behind each. North America and the effort that VertNet spearheaded with the US Node to bring hundreds of collections into compliance will be a key case study. Efforts in South America, specifically by SiB Colombia to promote open data, will be highlighted to provide additional perspectives. Creative Commons waivers (CC0), restrictions (BY, NC, SA), and how licenses are created will be discussed.

Keywords: Creative Commons, copyright, licences, waivers, data-sharing, data publication

<https://osf.io/6g4cb/>

The Berlin Skin Collection is under Observation – Testing Handheld XRF and Other Cost-Efficient Methods for Profiling a Large Collection

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GS-01 General Session Oral Presentations

The Berlin skin collection stores more than 30,000 mammal skins collected over the past 150 years. Investigations show that more than 80 % of the skins are in bad condition and threatened with degradation. The cause of the degradation is poorly understood and studies investigating treatment to stabilize them without causing further damage are rare. The two-year lasting skin conservation project at the Museum für Naturkunde in Germany aims at the development of methods for the analysis and treatment of degrading historic skins in natural history collections. Primarily, we focused on chemical ongoing degradation processes in skins, preservation methods used in the past but hardly documented and best practice in evaluation of the current state and condition of large collections. The results of the chemical analyses supported our hypothesis that acidic hydrolysis causes the main damage. Probably, the regarding acids are coming from the preservation techniques themselves and decrease the stability of the skins. Based on results of in-depth analysis, we are now working on the development of cost-efficient, non-invasive and simpler methods for a collection profiling to find similar characteristics in the skin collection. Handheld x-ray fluorescence analysis (pXRF), surface pH, penetration resistance, tear strength, test of flexibility and hair loss plus available information from the inventory catalogues are measured, collected and analyzed. The profiling includes skins from diverse species, collectors and collecting periods. First findings show that pXRF can be possibly used to determine preservation techniques. As far as we know, most of the Berlin skins were not mineral tanned. The skins were preserved by pickling or alum

tawing. PXRf Analyses show that the composition of detected elements depends on the collector and indicates the used preservation treatment. The next step will be the development of treatment methods to stabilize degrading skins. To stabilize those historic skins, the knowledge about the used treatment is essential. Different preservation methods need probably different stabilization treatments. We want to discuss with you our experiences of the profiling. We are still looking for recommendations and best practice examples of other cost-efficient and meaningful profiling parameters.

Keywords: mammal skin collection, degradation, profiling methods
<https://osf.io/mndbw/>

The Partnership of BOEM-ESP and Smithsonian NMNH-IZ: 40 Years of Collaboration and Expansion

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GS-02 General Session Poster Presentations

The U.S. Bureau of Ocean Energy Management – Environmental Studies Program (BOEM-ESP) has been conducting intensive environmental studies on the Outer Continental Shelf (OCS) in support of managing oil and gas development. Since 1979, the National Museum of Natural History, Department of Invertebrate Zoology (NMNH-IZ) has provided professional collection management services for the long-term curation of specimens obtained during these surveys of the U.S. Eastern, Western, Gulf, and Alaskan Coasts. The BOEM – NMNH partnership has recently expanded in response to analyses to

reveal that 88% (almost 9 out of 10 marine invertebrate families) have no genomic representation in public repositories. In an effort to reduce these gaps, NMNH-IZ is DNA barcoding existing BOEM collections, as well as forging partnerships with regional institutions to expand their holdings. These partnerships are providing new morphological vouchers paired with fresh tissue for DNA barcoding and deposition into the NMNH Biorepository for future genomic studies. Through these efforts, NMNH-IZ aims to improve the availability of high quality genetic information for the scientific community. To date, NMNH-IZ staff have cataloged over 295,000 specimen lots from 40 BOEM research programs into the Department of Invertebrate Zoology Collections. Of the 8,359 unique taxa within the BOEM-IZ collections, 1,559 have been designated as type lots with 352 new species discovered and described directly from material collected on BOEM studies. Work has been underway to sample specimens already in the collection but the best results are yielded from fresh tissue samples. As we continue to expand our program, we are hoping to collaborate with additional scientists and institutes that either have existing collections, or will be collecting in U.S. waters. BOEM-IZ staff can provide logistical support in field expeditions, including tissue sampling, barcoding and voucher preservation kits. We're also available for onsite subsampling and packing of voucher specimens to be shipped from the partner locality to NMNH for sequencing along with voucher cataloging and curation.

Keywords: BOEM, Smithsonian, Invertebrate Zoology, IZ, Genomics, Collections
<https://osf.io/4j279/>

Mind the Gap – A Workflow for Maintaining Data Connectivity Across Museum Collections

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GS-02 General Session Poster Presentations

A museum resembles a living organism, with individual parts (i.e. divisions) working together as a whole. Similarly, a single organism has multiple parts (i.e. tissues, parasites, etc.) that are curated together or independently, creating a wholistic specimen. When separate museum divisions curate these various parts, how do they maintain the data connectivity of the specimen as a whole? When an organism (i.e. bird, mammal, etc.) is collected, components such as tissues, parasites, blood slides, media, field notes, etc. must all be linked to a single voucher and their shared data. These various parts are then accessioned and curated by their respective divisions or may be sent to different institutions. The Museum of Southwestern Biology (MSB) at the University of New Mexico (UNM) has eight separate divisions, each with separate curatorial procedures. For example, a bird skin/skeleton will be curated by the Division of Birds, while the tissues from this bird are curated by the Division of Genomic Resources, and the blood slides and parasites are curated by the Division of Parasites. Each division has different rates of data processing and curation due to curatorial requirements and staffing, which results in parts of the same organism being curated at different times. In addition, data sheets, field notes, images, and other associated documents may or

may not be consistently associated with all parts of a single specimen across each division. As curatorial assistant in the MSB Department of Genomic Resources, I observed a time lag in specimen and data processing between the tissue archive and divisions that archived the voucher specimens. This processing lag creates problems for managing accessions and loans and lacks data continuity. Here, I seek solutions to improve the curatorial and data management workflow across divisions. I propose to develop a user-friendly, streamlined workflow that reduces the time lag in data processing and maintains the linkage between the specimen and associated parts during curation in different divisions of the MSB. I will use the Arctos Collection Management System (www.arctosdb.org), an online, multi-institutional database which provides a shared medium for linking related specimens and their data across divisions. Possible solutions I will be exploring include uploading “scaffolds” of the basic data needed for each cataloged specimen in each division so that the basic record can be added to over time. I will test this new workflow on newly collected avian specimens from Australia and the Solomon Islands.

Keywords: data-linkage, data connectivity, data processing
<https://osf.io/s7gve/>

Challenges of Linking Across Disciplines: The UNM Natural History Collections Club

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SY-15 Broadening Participation of Students in Biodiversity Collections through a Network of Student Clubs

The Natural History Collections Club (New Mexico Chapter) was formed in 2017 with the goal of promoting museums and their collections through various events, tours, and programs for students and the general public. The University of New Mexico (UNM) has at least five museums on campus in addition to three galleries. These museums encompass various disciplines, spanning from natural history (Museum of Southwestern Biology) to art (University Art Museum). Grants from the national organization provided travel funding for the former club president (Kaylen Jones) and co-president (Lindsey Frederick) to attend the annual meeting of the Society for the Preservation of Natural History Collections in Denver, Colorado in 2017. These club officers chartered the UNM organization, created a web site and Facebook page, and led the UNM chapter until their graduation in May 2017. The club then integrated with UNM's Museum Studies program in the summer of 2017. The name was changed to Natural History Collections Club/Museum Collections Club.

The UNM chapter of the Natural History Collections Club has brought museum-minded people together across multiple disciplines. In addition to hosting interdisciplinary events, we interact with students from various backgrounds including anthropology, art, geology, and museum studies. With such high diversity, we are able to gain different perspectives from other museum branches, thus strengthening our club. Furthermore, most students are focused on their museum and are unaware that other museums exist on campus. For example, most anthropology and art students did not know that the Museum of Southwestern Biology exists.

Since its creation in 2017 the club has hosted various activities. These include fundraising opportunities, tours, and workshops. The club provided parking assistance for over 1,000 visitors at the Coronado Historic Site, raising money that was put towards club activities. The club has hosted seven tours of various UNM campus museums including the Museum of Southwestern Biology, the Maxwell Museum of Anthropology, the Geology Museum, and the Harwood Museum of Art. The club also hosted a very successful interdisciplinary 3-D printing workshop, attended by over 20 participants from various departments. Recently, the club hosted a table and provided support for the opening of "Intertwined: the Mexican Wolf, the People, and the Land," an exhibit designed by former club president Kaylen Jones, about the New Mexico Wolf (Lobo) at the Maxwell Museum of Anthropology.

This year our club has very simple goals. First and foremost, we are trying to grow our membership base. Previously, students have entered the group and have proceeded to graduate just months later. Because of the graduate program in Museum Studies, the club has had more graduate student involvement than undergraduate. Many undergraduates are simply unaware of the multitude of museums the university has to offer. We hope to recruit more undergraduate students to hopefully build a strong base. We have plans to visit the New Mexico Museum of Natural History and Science and hold joint activities such as pizza and movie nights with UNM Geology students.

Furthermore, we hope to provide tours, events, and student volunteer opportunities that will encourage student and faculty engagement with campus museums. Once we establish a strong club group of interested and engaged students, we plan to expand our activities with additional workshops, guest speakers, events, and museum tours to out-of-state museums. A long-term term

goal is to have the club work with the Museum of Southwestern Biology and the USFWS to participate in the mounting of a specimen of the endangered Mexican Wolf, our campus mascot, for outreach and education.

Keywords: NHCC, museums, interdisciplinary, students, club
<https://osf.io/v2w9y/>

Arctos: A Collaborative Collection Management Solution

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GS-02 General Session Poster Presentations

Arctos (arctosdb.org) is an affordable, collaborative collection management solution serving global data on over 3.5 million biodiversity and cultural records and 775,000 media objects from more than 158 collections and forms the backbone of Harvard's MCZBase. It is a leader in providing museums with community-driven solutions to managing and

improving collections data and developing workflows for data cleaning and publication. Pioneered in 1999 and hosted at the Texas Advanced Computing Center, the portal (arctos.database.museum) provides numerous tools and services to manage data and make them publicly available. A web interface supports data entry and editing, and allows for geocoding, mapping, and object tracking as well as tracking transactions and usage. Arctos strives for superior data quality through its highly-normalized model, controlled vocabularies, and authorities. Standardized data shared among institutions have led to innovative ways of relating objects within or between collections (e.g., predator-prey, host-parasite relationships), promoting data exploration and interdisciplinary research. Arctos also leverages external web services to extend capabilities and generate reciprocal links with collaborators, including Barcode of Life, GBIF, GenBank, iDigBio, Global Genome Biodiversity Network, Global Names Architecture, Morphosource, National Center for Biotechnology Innovation, World Register of Marine Species, and VertNet. Furthermore, Arctos is a community of museum professionals who collaborate on best practices, trainings and webinars, and together work to improve data richness and expand functionality. Arctos collections benefit from this collaborative approach, and members have the opportunity to participate in its development through the Arctos Working Group. A robust research infrastructure, Arctos integrates biological, earth science, and cultural data as well as emerging data types such as environmental DNA and microbiomes for use by museum professionals, researchers, students, government agencies, NGOs, and the public. At a time when data discovery is imperative for research and conservation, Arctos provides a uniquely collaborative platform and community for bridging gaps between museum collections, informatics specialists, and data users.

Keywords: collection management system, informatics, community engagement, database
<https://osf.io/2tu8d/>

Linking Indigenous Botanical Knowledge with Western Science Plant Names

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GS-01 General Session Oral Presentations

Globally agreed conventions for naming plant species have primarily evolved to underpin western science and do not reflect how Indigenous communities view and use the world around them. But ignoring Indigenous ecological knowledge (IEK) disregards the wealth of knowledge and experience that these communities have and the contributions that Indigenous cultures can make to conservation and land management (1,2). But linking Indigenous and scientific plant names is incredibly challenging for many reasons. In Australia, Indigenous languages continue to decline with the number of fluently spoken languages estimated to have decreased by 90% in 1996 (3) making it difficult to record IEK. Another challenge is that relatively few Indigenous Australian language dictionaries exist and those that are available have been primarily built by linguists with limited botanical knowledge. In addition, the Australian National Herbarium (ANH) has examples of specimens collected by botanists with limited linguistic expertise that has resulted in incorrect or misapplied Indigenous names. Other challenges include that western science often recognises far more plants species than Indigenous communities do, there can be many Indigenous names for the same plant species as well as for

different parts of a plant (e.g. leaf, fruit, etc.). Perhaps the greatest challenge is, however, the large number of Australian Indigenous plant names and IEK yet to be recorded. Here we report the results of our pilot study that combined curation, botanical and linguistic expertise to explore the >1,700 plant species collected from Warlpiri lands in the central desert region held at the ANH. Our vision was to use these specimens to understand how we can better connect Indigenous Australians with plant specimens held in the ANH. We present our findings from the study and our concept for working with Indigenous Australian communities to explicitly link Indigenous and scientific plant names into the future.

(1) Ens & McDonald 2012 *Ecol. Mgt & Rest.* 13, 1

(2) Lullfitz et al. 2017 *Cons. & Soc.* 15, 201-216

(3) McConvell & Thieberger 2001 *State of Indigenous languages in Aust. Dep. Env. & Heritage*, Canberra

Keywords: Indigenous, plant, names
<https://osf.io/y36me/>

Portland State University Museum of Vertebrate Biology: From Endangered to Organized

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GS-02 General Session Poster Presentations

The Museum of Vertebrate Biology at the Portland State University, located in the heart of downtown Portland Oregon, is an integral part of the Department of Biology and Portland State University. It houses over 10,500 vertebrate

specimens (skins, skulls, skeletal and preserved materials) in five collections; Mammals, Birds, Fish, Amphibians and Reptiles, and Marine Mammals. These collections are extensively used for Biology courses, research, elementary through high school group tours, University outreach events, and loans to other Universities. We are currently working to achieve the Core Standards for Museums as defined by the American Alliance of Museums (AAM) – specifically in the two categories of Public Trust and Accountability, and Collections Stewardship - by raising our Museum practices to meet AAM’s National Standards and Best Practices for US Museums. Presently, the Museum is participating in the Standards and Excellence Program for History Organizations (StEPs) offered through the American Association for State and Local History as a first step toward the Museum’s ultimate goal of accreditation through AAM. However, while progressing through the Collections Stewardship section of the StEPs program, we have recognized the immediate need for proper specimen inventories and storage supplies, an Integrated Pest Management Program (IMP) and a formal Collections Management Policy (CMP) for our Museum.

Presented on this poster is an overview of the Museum’s five collections and the ongoing projects within each collection that are taking place to elevate the Museum’s practices from an endangered collection to one that meets National Standards.

Keywords: Endangered, Vertebrate, Collections Stewardship, Collections Management
<https://osf.io/e3aux/>

The Status of the Philippine National Museum’s Entomological Collections and the Management’s shift towards Better Collections Management

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GS-01 General Session Oral Presentations

The Philippine National Museum's Entomological Collections established after the Bureau of Science' destruction during the war has had to struggle to replace all its destroyed reference collections. No surviving records have been published to describe the inception of the Entomology Section in the National Museum and, consecutively, its valuable reference collections to create an overview of the diversity of the entomological fauna of the country. Collecting and curating these insect taxa poses a daunting task for any entomology curators, and with the loss of the original reference collections, the records of the insect diversity of the country before the war were also lost. Historical collections from the National Museum's Entomology section started to build up during the Philippine Zoological Expedition by the Chicago Natural History Museum in 1946-1947 and succeeding expeditions headed by Museum personnel in other parts of the country. Traditional Schmidt boxes and fabricated glass-covered insect boxes with cork-board pinning bottoms were used to house the insect specimens that corroded non-entomological pins used during the time. With the transition of the National Museum of Natural History in 2017 to its new home, the reference collection is undergoing a major overhaul by replacing the traditional insect boxes to new fabricated Cornell-type drawers (lined with "plastazote" foams) to ensure the conservation of its historical specimens and the construction of modern compactor shelving. It is also being re-cataloged to reconcile actual specimens from the surviving catalog to ensure research-valuable specimens are presented to the scientific

community.

<https://osf.io/9e7kq>

Collections Assessment Methodology and Impact On Management and Decision-Making: A Discussion on Uses and Lessons Learned.

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SY-09 Collections Assessment For Natural History Collections: From Local To Global

The Smithsonian Institution's National Museum of Natural History (SI-NMNH) developed a data-driven methodology to assess all of its collections in order to answer two essential questions: are the collections mission-appropriate and are they ready to use? This collections assessment method and its associated management systems have been in use on a regular basis for more than 10 years. The Collections Assessment rates all Museum collections on criteria related to condition, informational status, and significance, yielding standardized scores that can be viewed graphically to support rapid assessment, discussion and project prioritization. This methodology has improved cross-museum planning, grant proposal development, and has increased the efficiency of resource allocation and collaboration within the SI-NMNH. It has revolutionized decision-making. An important

element of the methodology is the grouping of large collections into subcollections that can be assessed and tracked as investments improve their status. A second important element is the representation of the data as dots on a graph. With investments over time, the dot for each collection is plotted in a new location so that the museum can show that its efforts “move the dots”. Elements of the methodology have been adopted by other Smithsonian art, history and culture museums, as well as natural history museums in London, Berlin and Leiden. In this symposium SI-NMNH will introduce the methodology and the essential collections grouping concepts that underlie it, and will describe the circumstances that led to the methodology’s development, its impact upon work, and its annual uses for collections management. Collections leaders from the Natural History Museum (London), Museum für Naturkunde (Berlin), and Naturalis (Leiden) will discuss their experiences and respond to questions from the audience about lessons learned from using the methodology, including implementation and management challenges and steps that promoted success, staff resource requirements, institutional benefits, and modifications they have made to meet the local circumstances and needs at their respective museums. The symposium closes with a discussion on the methodology’s potential for application across multiple institutions and the cross-institutional collaborations such implementations can support.

Keywords: assessment, collections, natural history collections, management, decision-making, prioritization, systems
<https://osf.io/5z32y/>

Rethinking Climate Control Strategies in Yale Peabody Museum Collections

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GS-01 General Session Oral Presentations

For the past few decades, climate standards for collections storage rooms have been treated using single set-points with strictly limited deviations in temperature and relative humidity allowed. The Yale Peabody Museum (YPM), in collaboration with the Yale Institute for the Preservation of Cultural Heritage, evaluated the current climate control strategy with an eye toward achieving a more practical and responsible approach, which considers the historic character of the buildings, high cost of climate control, and sensitivity to energy sustainability as Yale strives to reach carbon neutrality on or before the year 2050.

This new approach maintains conditions suitable for collections storage for dry natural history collections by modifying the way the HVAC system controls these conditions. Existing collections storage rooms in the YPM Class of 1954 Environmental Science Center, one of the highest energy buildings on Yale’s Central Campus, have been tested and modified and HVAC sequences are modified. These guidelines also inform HVAC systems in dry collections

created or modified as part of our ongoing renovation.

Several of the steps we are taking at the Yale Peabody Museum (and other Yale collections) include a shift from climate control to climate management, including: system maintenance, broader thermal criteria, dual set-point (dead band) controllers to reduce energy consumption and lower CO₂ emissions, nightly shutdowns of the air-handling system with occupancy overrides, and a reduction of the amount of fresh air introduced to the buildings. We will discuss limitations, adaptability, and benefits of sustainable climate control systems for natural history collections.

Keywords: climate control, collections storage, sustainability

<https://osf.io/he7zu/>

Research Contributions and Digitization Progress of Regional Herbaria

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SY-13 SCNet Symposium: No Collection Left Behind: Research Contributions of Small Collections

The specimens and associated data archived in herbaria are being used to address critical 21st century research questions related to climate change, invasive species, human health, and land use. In the United States alone we have over 660 active herbaria holding over 76 million specimens. The herbaria range from small regional collections of less than 5,000

specimens, to large international collections with millions of specimens and dozens of curatorial and collections staff. If looking at size alone, it is notable that over 85% of U.S. collections hold less than 100,000 specimens, and these “small” collections account for only 12% of the nations archived specimens. We propose that the realized or potential research contributions of data from these “small” collections exceeds that which can be quantified by size and number of specimens alone. We will present data on collections of various sizes and levels of digitization from several data resources (e.g., Index Herbariorum (IH) database, Integrated Biodiversity Biocollections (iDigBio) Collections Catalog, Global Biodiversity Information Facility (GBIF), etc.). We will use these data to define small collections relative to several variables including natural breaks in specimen numbers housed in herbaria, staff size, and institutional affiliation. Using the IH database and complementary datasets, such as the U.S. Census Bureau’s 2010 Decennial Census datasets and U.S. Environmental Protection Agency’s EnviroAtlas dataset, we will explore how institutional characteristics (e.g., institution size, ownership type), geographical setting (e.g., region, biodiversity hotspot), and local community demographics (e.g., race, age) vary among herbaria. We use the IH database, iDigBio Collections Catalog, and GBIF to compare digitization progress across herbaria and will discuss the relative holdings of different collection sizes. In summation, we will present a recently published case study that investigates the relative contributions of digitized data from different sized collections and the impact of these data on species distribution models.

Keywords: Regional collection, small herbaria, demographics, digitization

<https://osf.io/wrf5u/>

The Value of the Invaluable: The Challenge of Making a Scientific Collection Visible through Its Economic Estimation

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GS-01 General Session Oral Presentations

The Museum of Zoology at the Pontifical Catholic University of Ecuador (QCAZ, by its Spanish acronym) is the largest research center of biological resources in the country and houses, among others, the most representative collection of Ecuadorian mammals, with more than 17,000 specimens. This collection is a state and world heritage; its proper administration is a commitment that is fulfilled as long as institutions, government agencies, and society in general understand the importance of its preservation over time. This is achieved, not only through management policies that guarantee the durability and good use of the specimens, but also with the publication of the associated information and the justification for its continued financing and growth. Precisely, to highlight the importance of a collection such as the Mammals Collection at QCAZ, and through an effort between biologists and economists, a replicable method to estimate its minimum economic value was proposed. The direct and indirect costs associated with the collection, preparation, and transportation of mammal specimens were analyzed from detailed budgets and taking into account aspects such as labor force, basic equipment, consumables, and management of resources during four 20-day long trips. We

determined that the average cost per specimen was USD\$74.70. However, because the number of specimens caught in an expedition can vary, 36 expeditions varying in length between 2003 and 2016 were used, and each expedition was assigned a total cost based on the number of work days, at the baseline total cost per day obtained. As a result, it was estimated that the average cost per specimen approximates USD\$72.00, which produces a total cost of the current collection of more than one million dollars. We believe that monetary values are well-understood units of comparison when the relative importance of some things, in this case, of scientific collections, is communicated and justified.

Keywords: Economic value, financial exercise, natural history collection, mammals, voucher specimens

<https://osf.io/85d9x/>

Project Macroinvert: Bringing Aquatic Macroinvertebrate Collections Out of the Dark at Arkansas State University

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GS-02 General Session Poster Presentations

The Arkansas State University Museum of Zoology (ASUMZ) Aquatic Macroinvertebrate collection at the Arkansas Center for Biodiversity Collections (ACBC) houses approximately 130,000 specimens (17,000 lots). The collection includes specimens from North and Central America and Australia, but most of the specimens were collected in Arkansas by George L. Harp and his students from the early

1970s to his retirement in 1999. Since then, the collection has been stored and not well curated. Project Macroinvert was initiated at the ACBC in fall of 2016, which involves restoration, digitization, and georeferencing of the collection by undergraduate and graduate students. Until recently, specimen data were stored in handwritten catalogs, making query and locality mapping cumbersome and time consuming. To date, approximately 95% of the collection has been digitally databased, with approximately 50% of the records having sufficient data for georeferencing. To highlight the utility of data unlocked by Project Macroinvert, we map and describe distributional data from ASUMZ specimens in the orders Odonata (Dragonflies and Damselflies) and Ephemeroptera (Mayflies). We expect that digitization and georeferencing of small collections, such as the ASUMZ collection, will contribute vastly to our knowledge of species distributions and our ability to accurately characterize biodiversity at fine scales.

<https://osf.io/2xgky/>

Unossified Skeletal Preparation: Challenges and Applications

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GS-02 General Session Poster Presentations

Using a dermestid beetle colony (*Dermestes maniculatus*) to clean skeletons is a prominent component of vertebrate specimen preparation. Despite this, specific methods for cleaning and

preserving skeletons with dermestids are not well recorded. Problems with dermestid cleaning methods emerge when preparing the skeletal material of unossified or sub-adult vertebrates. Large dermestid larvae can easily bite through thin cartilaginous elements in individuals, quickly consuming features or entire specimens if not properly monitored. These developmental features are often too delicate to detect in digital scans of carcasses, therefore the physical preservation of osteological material is required to observe and maintain such developmental data. Thus, we sought to find a simple method that allows vertebrate preparators to protect unossified bones from destruction in a dermestid colony. Techniques explored in this experiment involved creating physical barriers to protect unossified specimens rather than relying on the potentially hazardous chemical techniques recommended in the past. Utilizing common items, such as commercial mesh screens and plastic containers, we developed a method to safely and economically control the size of the beetle larvae that feed on a specimen. We found the inserting of a mesh screen on the side of a fully enclosed plastic container was the most effective in cleaning subadult vertebrate material. A 1mm x 1mm mesh allowed small dermestid larvae to access the specimen and remove flesh without destroying unossified skeletal material while preventing larger, more destructive dermestid larvae from entering the container. We recommend this new technique to effectively expose and preserve details of the skeletal growth and development of small- and medium-sized vertebrate specimens.

Keywords: dermestid, beetle, sub-adult, unossified, skeleton, preparation, vertebrate, cartilage
<https://osf.io/zk3ac/>

How Did This Get Here?

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SY-03 Interconnectedness Of Data

Who is J.S. Warmbath, and why did he bring us bees from Grinnell Land? Where IS Grinnell Land? A simple matter of data verification during a digitization project led to the rediscovery of forgotten human links between some specimens and artifacts in the Milwaukee Public Museum Collections. We have found that when we ask “How did this get here?” we are getting some unexpected answers. This talk will tell three collector and expedition stories from the late 1880s to the early 1900s and discuss how they have provided new opportunities for research, outreach, and helped reconnect our collections to the wider world.

Keywords: Museum Collections, Milwaukee Public Museum, MPM, Anthropology, Natural History
<https://osf.io/7gk4y/>

Preservation of Wet Collections: Non-Invasive Fluid and Containers Identification Using Micro-Raman Spectroscopy

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GS-01 General Session Oral Presentations

Preservation of fluid collections requires knowledge about fluid compositions (e.g. preservatives used to preparer specimens), degradation products and jars. While formalin, ethanol or isopropanol were widely used, many

other chemicals could have been added in mixtures. Unfortunately, fluid composition were scarcely recorded during the initial preparation of the specimens, and even during re-conditioning operations until fairly recently. Moreover, fluids may evolve during storage through evaporation, oxidation or leaching of products coming from the alteration of the specimen, the sealant or the jars.

Several methods have already used to identify and titrate current fluids in collections. Practical and accessible, they are based either on colorimetry or on liquid density measurements but difficult to use for mixtures.

Keywords: wet collections, fluid identification, formalin, ethanol, glass jars, Raman spectroscopy
<https://osf.io/xvjh8/>

CSIRO's Collection Manage Service: A Collections Data Ecosystem Approach to Better Connecting Disparate yet Related Data

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SY-03 Interconnectedness Of Data

CSIRO's Nations Research Collections Australia, has been focusing on a broader concept of a collections ecosystem, which is more than just a system and enterprise architecture. This ecosystem in combination with employing the F.A.I.R. principle (https://en.wikipedia.org/wiki/FAIR_data) is key to better connecting specimen data internally and externally.

CSIRO over the past 8 years have been working towards building such an ecosystem. Core elements such as an enterprise scale Digital Asset Management system, and a world leading aggregation platform to share collections

information. In the last few years new effort has been put into developing a third key element to manage the collections data in the form of a single multi-collection management system (CMS).

When complete, the CMS will form the central platform in the ecosystem that connects CSIRO's internal systems to each other, as well as linking into research infrastructure, utilising new approaches to data interpretation such as Artificial Intelligence (AI) and other international initiatives such as GenBank.

In a shifting world there are many challenges that face this ecosystem, including the change challenge, improved and new technologies such as AI and Machine Learning as well as the concept of Internet of Things.

<https://osf.io/9ze53/>

A Collections Perspective: a Case Study on the Benefits and Costs of Using Crowdsourced Transcription Services.

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SY-04 Crowdsourcing Digitization: Partnerships, Platforms, And The Worldwide Engagement For Digitizing Biocollections (Wedigbio) Event.

Digitisation is being accelerated at the CSIRO National Research Collections of Australia (NRCA) through the public's participation in transcribing varied specimen and specimen related assets. Without this participation this data would not become accessible to the scientific and research communities until much later, if at all.

DigiVol, a crowdsourcing platform developed by the Atlas of Living Australia (ALA) is utilised by many institutions around the world as a way

of combining the efforts of online volunteers to help speed up the process of transcribing natural history collections data. The DigiVol transcription service is a critical component to the digitisation program within CSIRO's NRCA.

Using DigiVol and linking it to our other systems provides many benefits, but also has some costs. Using our experiences at CSIRO we will discuss these benefits, outline what costs we have uncovered and how we are dealing with them.

<https://osf.io/u39nq/>

Impacts of Big Data Quality and Error in Digitized Collections

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GS-01 General Session Oral Presentations

In light of growing unencumbered public access to federated, online natural history collection data, the quality and validity of digitized specimen data must be more carefully evaluated than ever before. To this end, this project assessed the frequency at which museum specimens are erroneously identified and the extent to which these errors might impact specimen-based ecological study, using four closely related chipmunk species (Genus: *Tamias*) as a model group. Based on a combination of skull morphometrics, pelage, and locality, 5.6% of 1009 *Tamias* specimens investigated were found to be misidentified. These errors occurred largely when taxonomic revisions went unaccounted for in historic collections management, as well as when

collectors mischaracterized specimens where species ranges overlap. Ecological niche models showed that verifying voucher specimen identity has observable impacts on predicted species' distributions and that errors would tangibly affect ecological conclusions drawn from these specimens' digital records. To mitigate these issues, natural history collections should prepare specimen using techniques that intentionally preserve species-specific diagnostic features (e.g., extracting and preserving small mammal genital bones); participate in active discourse with researchers to ensure that expert feedback is recorded and published to the collection's public data set; and maintain and share longitudinal records of specimen identification determination history. Further, because small collections collectively preserve a substantive proportion of overall museum specimens, but have historically enjoyed less access to discipline-specific curatorial expertise, study findings highlight the need for on-going curatorial support to small collections and their inclusion in community knowledge-sharing initiatives, for example via Thematic Collections Networks.

Keywords: specimen digitization, biodiversity informatics, data quality
<https://osf.io/3tzm9/>

Lightweight, Rigid Support Cradles for Fragile but Heavy Specimens, Made from an Epoxy Clay Compound

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SY-10 Storage Techniques For Art, Science, And History Collections (STASH) Preventive Conservation And Storage: STASH Flash II

In 2014 the Section of Vertebrate Paleontology at Carnegie Museum of Natural History (CM) received a grant from the Institute of Museum and Library Services to upgrade storage of the 472 holotypic specimens in the collection. Initially, cradles of plaster reinforced with fiberglass and lined with felt were created. Although supportive, the plaster cradles were heavy, tended to break, and shed fiberglass splinters when handled. An alternative method was needed.

To address this issue, we modified a technique used by Mr. James Leacock of Multiform Studios to create exhibit mounts for CM's Mesozoic gallery, *Dinosaurs in Their Time*. Unfortunately, the marine epoxy that he used, Pliacre™, is no longer available. Therefore, we experimented with three other products and found that Apoxie Sculpt™—a self-hardening, two-part, permanent, waterproof epoxy clay compound—was the best substitute.

The cradles consist of mixed epoxy clay rolled flat, lined with acrylic felt, and custom formed. The epoxy clay allowed for specialized, less messy cradle creation for medium to large-sized fossil mammal skulls, jaws, and postcranial bones with great success. Cradles made using the epoxy clay are durable, light weight, and add little to specimen height, which makes for efficient use of storage space. The only disadvantage of these cradles relative to their plaster counterparts is the greater cost of the epoxy clay; consequently, this method is not cost-effective for very large specimens such as sauropod dinosaur limb bones.

In addition to low profile storage mounts, this method has been used to create exhibit and traveling mounts. This talk summarizes our process.

Keywords: custom, lightweight, rigid, cradle, storage, epoxy clay, acrylic felt
<https://osf.io/ax4sw/>

**Do We Really Want to Do This Again!?
Taking Advantage of Aggregators to Harvest
Existing Digital Data to Efficiently Grow
Your Natural History Collection**

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SY-05 Managing And Digitizing Large Collections

The online availability of digital collections, particularly at aggregator sites, provides opportunities to curate physical collections in novel ways. Shifting traditional curation practices to make use of data available at other institutions can reduce the amount of time needed to accession and digitize specimens. The University of Colorado Herbarium (COLO), project lead of the Southern Rocky Mountain Thematic Collections Network of iDigBio, has developed strategies to harvest and match records from other collections and existing data. Data are customized for a specific collection including barcodes, accession numbers and collection specific nomenclature. During this talk, we will present case studies which illustrate these methods using collections diverse in scale and origin. We then offer suggestions on how other institutions can make a similar transition, thereby streamlining digital processing. We explore the enhancement of georeferencing techniques such as batch georeferencing of duplicates, shared across institutions, which could benefit the greater collection community. The ultimate effectiveness of these methods, however, are dependent upon the data available: risks of perpetuating errors through harvesting inaccurate or incomplete records must be recognized. We anticipate the adoption of these techniques across institutions will serve as a

catalyst for greater transparency and communication between shared collections, improving data quality through time.

Keywords: digitization, work flow, transcription, biodiversity informatics

<https://osf.io/szwmv/>

Changes in Lepidoptera Collecting in the United States Since 1800

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GS-02 General Session Poster Presentations

Specimens of living things have been collected for centuries, and insects in particular have been included in such activities from the beginning due to their size and interesting appearances. The NSF-funded LepNet project aims to database the specimen label information for collections of Lepidoptera held in various US institutions. This project investigated the changes in collecting activity over time as reflected in the data generated through LepNet. Collection efforts have been inconsistent across both time and space.

Keywords: big data, butterflies moths, data base

<https://osf.io/rgyzm/>

Life after Death: Modern Research on a Historical Mussel Collection.

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SY-13 SCNet Symposium: No Collection Left Behind: Research Contributions of Small Collections

The freshwater mussels collections of the Milwaukee Public Museum are historically important records of the fauna of Wisconsin streams and rivers. Two significant areas of research are currently being performed using the Museum's collections. The first, an investigation of morphological and allometric ratios in mussel shells, compares physical measurements taken directly from shells against measurements from a digital image of the specimens taken during specimen digitization. Analysis of these data reveal general morphological and allometric patterns, as well as compare the fidelity of the digital measurements (collected via crowd-source transcription) to the physical measurements. The second avenue of research explores the chemical composition of a series of shells collected in the early 1900's by the Milwaukee Public Museum using a handheld XRF. In preliminary analyses, we found no evidence of differences between locations on a single shell, however we did find variation in elemental composition along the north-south gradient sampled.

Keywords: Unionidae, XRF, morphology, museum collections

<https://osf.io/wczus/>

From Scraps to Cache: A Case for Structured Education Collections

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SY-06 Collecting Measures Of Success

The silent consensus is that, whether for classroom teaching, museum education, or public outreach, education collections belong to the land of misfit specimens owing to their lack of metadata important for scientific research. Such specimens are often undocumented or unorganized, making it difficult to effectively use the materials for their intended purpose—teaching. The Indiana Geological and Water Survey (IGWS) has built a substantial inventory of specimens in its Education Collection, comprising more than 2,200 rocks, minerals, and fossils. Although one of the smallest collections of our institution, it is one of the most visible and publicly accessible. Each specimen has a unique identifier and metadata record using elements derived from Darwin Core and institutional standards. Aside from catalog numbers, specimen records range from full to incomplete to having no record at all. Regardless of the completeness of the record, specimens remain in the collection if they have the potential to be interpreted within public outreach programs. Approximately two-thirds of IGWS outreach programs incorporate specimens from the Education Collection, including Master Naturalist workshops, STEM career fairs, Science Olympiad competitions, library programs, and our recently developed Discovery Trunk loan program. After each event, specimen records are updated, adding increased documentation of collection use. The introduction of accessioned specimens into outreach events has strengthened the impact of our educational activities, provided a basis for discussing the importance of natural history collections to those outside of the museum community, and improved public understanding of how preserving such collections is part of our organizational mission. We posit that the perception of education collections must change from oft-discarded scrapyards to caches of opportunity to engage the public in accessible

natural history collections. Structuring education collections with organized metadata schemas and curation brings the rigor of collection documentation to the hands, eyes, and ears of the general public and provides an opportunity for people to build respect for natural history collections on a very personal level.

Keywords: education, geological specimens, metadata, structure
<https://osf.io/ea7ur/>

Square one: Planning a Digitization Project of an Uncatalogued Collection from Scratch

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GS-01 General Session Oral Presentations

William Rainey Harper College is a community college based in Palatine, Illinois, with one of the largest geologic collections in the nation amongst community colleges. This never-been-catalogued cosmopolitan collection consists of minerals, rocks, fossils (Paleozoic to Cenozoic), sediments, and maps, with specimen data on paper scraps. Previous and current faculty built the collection along with community donations. However, only a limited number of specimens are used for lectures and labs. In an effort to enhance course offerings in the geological sciences and increase enrollment, digitizing this collection would help the college to:

- Revitalize courses with new labs and materials to increase enrollment and student success
- Increase student participation in independent study research
- Track what specimens are available for teaching, researching, and identifying gaps in the collection
- Keep a record for future use

- Create kits for schools in need of teaching materials
- Allow other departments to search the database for materials

Available software limitations, faculty load and requirements, lack of staff, and time constraints are obstacles to digitization. We are searching for grants to create a full-time collection digitizer position and to purchase collections management software. If grants are not secured, this project would need to continue with a volunteer and Microsoft Access. The database will be built with faculty input and cataloging methodology with specimen type, number, and a suffix, if needed. Upon completion, this project could be a template for other schools to digitize their collections. Implementation of the project will begin Summer 2019.

Keywords: planning, digitize, digitizing, uncatalogued, cataloging, community college
<https://osf.io/cmvpj/>

Digitizing the History of the Ordovician: Between a Rock and a New Building

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SY-05 Managing And Digitizing Large Collections

Milwaukee Public Museum has completed one year of a three year IMLS supported digitization project, Digitizing the history of the Ordovician: From biodiversification to extinction in three collections. The cooperative project will convert the paper based records of the Ordovician fossils collection at three institutions to digital form. In addition, the collection staff at MPM is preparing for an anticipated move to a new facility within ten years. Digitizing an historic collection and preparing for a move to a new building present challenges. Where do you begin and how do you

integrate relocation preparation into a digitization project? Can technology help?

The MPM collection, organized by locality and age, includes a mix of previously cataloged specimens and specimens with only a locality number. The procedures for MPM's digitization have to accommodate both capturing the cataloged specimen numbers and assigning new catalog numbers to specimens with only locality numbers. A supplementary step of generating machine readable QR code (Quick Response Code) to cataloged specimens and museum storage locations was included to facilitate automated data retrieval. The workflow began with a collection survey, a phase one of capturing the cataloged specimens' data, specimen label images and specimen images with QR codes included. Over the next two years, phase two of the project will curate the uncatalogued specimens, assign catalog numbers, generate digital records, and create specimen images along with QR codes for specimens and storage locations.

The project work is being completed by local university students with a background in the Geo-sciences and museum volunteers who have an interest in geology.

Keywords: Ordovician, Quick Response Code, Digitization, fossils
<https://osf.io/36yt4/>

Making a virtual natural history museum that counts: GBIF, collections and an alliance for biodiversity knowledge

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Plenary

On July 4, 2018, GBIF.org indexed its one billionth species occurrence—an observation of a frilled anemone (*Metridium dianthus*) in the waters of Saint-Pierre and Miquelon, a French archipelago in the northwestern Atlantic.

Included in a massive update from France's l'Inventaire National du Patrimoine Naturel, this single record embodies both the heritage and the prospects for GBIF—the Global Biodiversity Information Facility:

- its future, as it addresses taxonomic and geographic data gaps, as a marine invertebrate observed off the coast of an underrepresented overseas territory
- its present, as a record created within a citizen science platform—in this case, one that enables divers exploring marine environments to contribute to a national inventory of underwater species
- and its origins, given that the BioObs programme that contributed the record is hosted by le Muséum national de l'Histoire naturelle, a centuries-old institution with deep roots in the Enlightenment

GBIF arose from a 1999 call for the establishment of 'a global biodiversity informatics facility' from the Biodiversity Informatics Subgroup of the Organization for Economic Cooperation and Development's Megascience Forum. Established in 2001—thanks in no small part to the support and enthusiasm of natural history collections around the world—GBIF today comprises a research infrastructure and network of more than 1,400 institutions in 125 countries that provides researchers and policy makers with unrivalled

access to free, FAIR and open data about all life on Earth.

The GBIF network shares four centuries' worth of evidence about where and when species have been observed or collected, drawn from many diverse sources. In recent years, long-term contributors like biologists and field researchers, IT professionals, collections curators, biodiversity informaticians and data scientists have been joined by more than 1 million individual participants whose voluntary efforts share an unprecedented volume of data through recording societies and citizen science projects around the world.

But what can we do to ensure that these collective achievements continue to benefit the collections community? This talk will highlight and explore recent examples while calling for a broad-based global alliance for biodiversity knowledge aimed at improving the alignment of efforts across the whole biodiversity informatics community—while tackling both persistent and emerging issues faced by natural history collections, the institutions that host them and the professionals whose work will preserve and protect their scientific and cultural value for future generations.

Keywords: open science, network, infrastructure
<https://osf.io/c397g/>

The GDPR-Compliance Waltz: Balancing Necessity, Legitimate Interests and Data-Subject Rights in the GBIF Network

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SY-02 Licensing And Rights Around Collections Data
 And Media

GBIF has legitimate interests in collecting and maintaining the information needed to provide biodiversity-related evidence that supports scientific research and policy. Beyond that, we collect the minimum amount of personal information needed to fulfill the purpose of your interactions with us. We don't sell this information to third parties, and we process it only as described in this Privacy Notice. As an EU-based body, we comply with the General Data Protection Regulation (GDPR). But regardless of where you come from, where you are or where you live, we apply the same standard of privacy protection to all our users.

Working from offices in Denmark, the GBIF Secretariat had both an interest and a responsibility to understand the implications of the European Union's new General Data Protection Regulation (GDPR) on its operations. As might be expected, the most pressing issues revolve around compliance with new requirements on processing personally identifiable data.

GBIF's host country agreement with Denmark and the globally distributed nature of its network creates some unusual if unexceptional circumstances. But while seeking legal advice, we held firm on two principles: 1) that GBIF is an international organization, as defined by the GDPR and 2) that our commitment to openness and transparency requires acting as if any processing of personal data by GBIF is subject to the terms of the regulation. A thorough assessment of GBIF's legal basis for processing personal data highlighted additional recommendations on how communicate and maintain best practices across the network.

Much of the attention and comment about the GDPR focused on consent-based permissions, but it's important to recognize that the GDPR includes significant exceptions for research.

Moreover, the regulation does not establish individual consent as the one and only basis for legal compliance.

In fact, in many cases, the names of individual observers, collectors, curators and even GBIF network staff are critical for maintaining data provenance, scientific credibility or operational integrity. For this reason, GBIF claims necessary and "legitimate interests" in collecting and maintaining such information to provide biodiversity-related evidence that supports scientific research and policy—even where such information may be personally identifiable.

In practice, the GDPR requires that these interests be balanced against the rights of individuals, though the alignment of GBIF's interests with those of the wider scientific, research and policy communities and, ultimately, the public, likely weighs in GBIF's favour.

What's the case with GBIF may differ elsewhere in the chain of provenance, though, so GBIF has accepted a recommendation that we seek to inform individuals of its privacy policy via our network. A planned twice-yearly email communication to all data publishers will share details on how GBIF itself handles and processes of personal data and advise them on best practices, hoping to help ensure the network's compliance with personal data processing requirements.

Keywords: gdpr, personal data, data privacy
<https://osf.io/9r26b/>

Giving Credit Where Credit's Due: Demonstrating the Value of Sharing FAIR and Open Biodiversity Data by Linking DOI- Based Research Citations to Publishers and Datasets

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SY-03 Interconnectedness Of Data

The institutional incentives for sharing open data remain poorly defined or underdeveloped, frequently relying on the eagerness and willingness of key staff to take leadership in demonstrating the value of such practices. Funders' wider adoption of open data policies has amplified the pressure to share, despite lingering questions around best practices and who pays for such activities, among others. An evidence-based business case for the value of sharing data—one that extends beyond anecdotes and value statements—at times seems elusive.

GBIF is an open-data network and research infrastructure funded by the world's governments. Its community consists of nearly 100 formal participants and more than 1,300 data-publishing institutions, which currently share tens of thousands of datasets containing more than 1 billion species occurrence records. This data is freely and publicly available for discovery, use and reuse across a wide range of biodiversity-related research and policy investigations.

Starting in 2015, GBIF introduced the DOIs as persistent identifiers for the datasets shared through its network. This feature was soon extended to user downloads from GBIF.org, assigning DOIs to the filtered results of their taxonomic, geographic, temporal and other search terms.

Since that time, GBIF has established and maintained a robust system for using these DOI citations to track and link FAIR and open data downloads with research uses. This system

provides a strict, transparent accounting of citation counts by dataset and institution.

Despite being introduced without accepted standards for citing data, the practices of researchers and journal publishers are becoming steadily more consistent, enabling the GBIF infrastructure to support open, transparent, persistent and repeatable use and reuse of species occurrence data. As a result, GBIF is increasingly able to trace the provenance of data use and reuse back to its sources and connect related citation results back to dataset and publisher pages. Such quantifiable results offer institutions more traceable, trustworthy evidence of the value of sharing data to support others' research.

<https://osf.io/wg94h/>

Customized Boxes for Human Remains and Associated Grave Goods

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SY-08 Making The Case For Anthropology Collections

At the Carnegie Museum of Natural History, our archaeological collection from the Upper Ohio River Valley boasts a total of over one million objects. Our institution served as the repository for the State Museum of Pennsylvania until the nineties. Our staff consisted not only of curators, a conservator, and a collection manager, but also full-time field archaeologists. These archaeologists completed field surveys and excavations, amassing the bulk of the collection. Prior to this, the museum had been collecting archaeological material for decades. Since the museum was established in 1896, material that was collected before NAGPRA laws resides in the collection. The law is amended frequently. Repatriation is a slow and ever-changing process

and many repatriations take years to complete. Some human remains are not eligible for repatriation at this moment, but that may change. Currently, the burials housed at the museum are not being requested for repatriation and we are compliant in the eyes of the law.

It is a common practice at many institutions to create uniform storage for human remains. These remains are stored in identical boxes on even shelving, so that calculations of necessary space can be made easily. However, this means that most of the time associated grave goods are stored separately from the remains, so the organization of human burials in storage does not reflect what they would have looked like in the ground. At the Carnegie Museum of Natural History, boxes have been custom made to include both human remains and their associated grave goods. Box making techniques have been developed to include both the bone and the associated objects. Respect for the individuals in the collection is the most important aspect, so maintaining as much dignity as possible in storage should be the goal. In the case of human remains, reverence should outweigh efficiency. While this project is nowhere near completion, steps are being taken to preserve the integrity of the individuals and their hopes for the afterlife.

Keywords: Human Remains, Grave Goods, Storage, Boxes

<https://osf.io/dzakp/>

Reuniting the Canadian National Mineral Collection: Collection #1 - Moving Radioactive Minerals

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GS-01 General Session Oral Presentations

As part of the Geological Survey of Canada (GSC) and the Canadian Museum of Nature (CMN) agreement to re-unite the National Mineral Collection (NMC), the radioactive mineral collection from the GSC was chosen as the first part of the mineral collection to move to the CMN. The GSC has an extensive collection of radioactive field samples and continues to collect Naturally Occurring Radioactive Material (NORM) as part of their current research programs. In order to make room for new samples in the overcrowded radioactive vault, over 700 NMC specimens were assessed and prepared for transportation in 2018. Each specimen was catalogued, bagged, wrapped, and packed into pails certified for the transport of dangerous goods. Each pail was weighed, the dose rate measured and specific activity calculated. The dose rate was used to strategically pack samples for transportation by a contractor specialized in moving dangerous goods. In order to avoid the potential transfer of museum pests, identified as being present in GSC collection rooms, the pails were frozen for a week before being moved to the CMN's radioactive room. Along with the usual logistical concerns of breakage, information loss and dissociation, moving NORM samples comes with a duty of care to workers at each institution. To alleviate any concerns expressed by museum staff, radioactivity was measured before, during and after the move in work areas near the freezers and storage area. Working with researchers experienced in handling NORM at all stages of this project, resulted in clear and timely communication and was the key to the success of this multi-stage move. Once the pails were placed in the CMN radioactive vault, the samples were unpacked in the main mineral

collection room with tarps, PPE and wet wiping to eliminate contamination. The NORM samples of the NMC are now permanently stored in three cabinets in a controlled radioactive room at the CMN.

Keywords: NORM, Radioactive, Moving collections
<https://osf.io/u96fw/>

Best Practices for Destructive Sampling in Vertebrate Palaeontology

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SY-14 Best Practices in Destructive Sampling: Methods
for Limiting Specimen Information Loss While
Maximizing Research Potential

Traditionally, vertebrate palaeontology research has focused primarily on the use of data from morphology and geology in order to describe new species, study functional traits, gain insights into the evolution and ecology of extinct organisms, and more. However, in other cases, increasingly so in recent decades, data for palaeontological research has derived from the destructive sampling of fossils. Destructive sampling in palaeontology includes methods such as thin-sectioning or coring for bone histology, powdering or laser ablating specimens for isotopic analysis, and de-mineralizing samples for soft tissue studies. While these methods, by their nature, destroy some or all of a given fossil specimen, they often yield data critical to advancing research interests and testing hypotheses related to the evolution and ecology of extinct organisms that would otherwise not be possible. This naturally can lead to disagreement between researchers and collections/curatorial staff, as priorities may differ on the importance of conserving a specimen vs. advancing scientific goals. Thus, it is imperative that methodologies and 'best

practices' be developed and implemented to both conserve the maximum amount of data from specimens selected for destructive sampling, and to minimize the amount of material that needs to be destructively sampled, where possible. To that end, I will discuss a number of policies and practices that have been developed for this purpose, via case studies demonstrating their implementation. These include, but are not limited to: photography and 3D scan techniques, molding and casting of specimens or specimen-components prior to histological analyses, the use of technologies to extract micro-samples of specimens rather than completely destroying them when performing isotopic or elemental analyses, and steps that can be taken after partial destructive sampling to restore specimens to a condition that retains original parameters of shape and size. Combined with careful specimen selection criteria, these practices should allow a balance to be achieved that facilitates research while also maximizing the preservation of important collection resources for the future.
Keywords: vertebrate palaeontology, destructive sampling, conservation
<https://osf.io/8jhkb/>

Overdue Loans: How Do We Get Our Specimens Back?

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SY-05 Managing And Digitizing Large Collections

Management of large collections are fraught with challenges but perhaps one of the most vexing is the tracking of loans. The success of this collection activity frequently lies beyond the collection manager's immediate influence and may require the encouragement and education of users to follow collection best practices. So how

do we go about tracking specimen loans, reminding collection users to follow good collection practices, and getting those loans returned that are long overdue? In 2016, the Museum of Comparative Zoology (MCZ) started an initiative to capture and clean-up existing loans in the museum-wide database, MCZbase, to facilitate the process of sending out auto-notifications for overdue MCZ loans. The results have been successful and auto-notifications have greatly increased the timely return of current loans, as well as the final return of historical loans, including several 40+-year-old loans in the paleontology collections. In addition, the MCZ implemented the means to manage incoming loans (Borrows) to the museum, including auto-notifications for these outside loans; thus, helping to ensure that MCZ researchers do not end up on other museums' lists of overdue loans. This level of tracking has gone a long way to ensure that MCZ loans are being returned and other museums' loans are being sent back in a timely fashion. It has also helped the collection managers facilitate these activities without being the bearer of typically unwanted reminders.

Keywords: overdue loans, auto-notifications, outgoing loans, incoming loans
<https://osf.io/8ufd9/>

Depicting Extinction and Evolution

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SY-07 Interns And Young Professional Showcase (Poster Session)

Natural history collections, zoos, and aviaries are important resources for illustrators depicting both past and present biodiversity. Cai Czuhai, a senior at Randolph College majoring in Studio Art with a minor in Biology & Museum and

Heritage Studies, elaborates on the processes by which illustrators make use of these resources, the advantages and drawbacks of each, and how living species can help artists to interpret lost ones. This poster highlights Czuhai's sketches, drawings and paintings of extinct birds and their living relatives, which comprised their senior capstone project.

Keywords: art, illustration, speciation, bird collections

<https://osf.io/2knex/>

Making Sense of a Hot Mess: The Case for Archives in Anthropology

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GS-02 General Session Poster Presentations

The importance of a properly-maintained and organized archive lies in accessibility to researchers and preservation of the department's project history, i.e. the history of which sites and projects were undertaken by former Carnegie Museum staff such as Richard George and Verna Cowin. Prior to the museum receiving its NEH grant, the archival collection was scattered throughout multiple locations in the Edward O'Neil Research Center. After re-configuring the floor plan of the Research Center to accommodate new artifact storage, the archives were consolidated into one location on the ground floor.

The process of organizing the collection then began with the taking of a general inventory, proper re-housing of the paper and photographic collections, and the creation of finding aids. A finding aid's purpose is twofold: to allow the anthropology department to have a clear and

concise idea of what we house in the archival collection, and to allow potential researchers and colleagues to easily access a list of what data can be found in the archives and where to find it. Collections currently being processed in the archives include: the papers of Richard George; the papers of Verna Cowin; research by multiple authors concerning sites in the Upper Ohio Valley; the photographs, slides and related notes on the Yanomami people of Brazil by Father Matthew Tosello; the petroglyph research of James Swauger; site data by multiple authors on all archaeological sites in Western Pennsylvania; various, incomplete site data for Eastern Pennsylvania sites and sites in other states; and planning notes for past exhibitions in the Anthropology department. The site data for Pennsylvania, which constitutes over 1000 sites, is currently being digitized to allow for easier access both within and outside the institution.

Keywords: archives, anthropology, collections, archaeology

<https://osf.io/z54ar/>

Helping the Herps: Restoring the Past for Arkansas State's Future

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GS-02 General Session Poster Presentations

The Arkansas State University Herpetological Collection dates back almost ninety years and contains approximately 34,000 specimens. To increase the efficiency of this collection, the collection will employ a simple, yet dynamic, cataloging system that expedites the location of specimens by taxonomic level. It will be an accessible tool for anyone and everyone interested in the world of herpetology. However,

the collection suffered from a lapse in proper curation and many specimens were stored in seemingly random order in leaky jars and stale alcohol and kept in an unsanitary environment. To overcome these obstacles, various students and faculty members have composed a plan to address these issues and prepare the collection to reach peak performance. In a multi-phased process, the team will transfer specimens to new jars and ethanol to prevent ethanol loss and eventual desiccation. Correctly labeled jars are then shelved by phylogenetic relation. Later phases will establish a cataloging system that quickly locates curated species, while also making the addition and lending of specimens convenient for curators. In the past year, these efforts have already brought the area out of its severe disarray, cleared the space's unsafe conditions, installed new shelving, and replaced a multitude of jars. At its full potential, this collection has the capability to bolster research and educational endeavors both on-site and beyond the university. Such an impressive collection will undoubtedly provide questions, answers, insight, and inspiration to generations of students to come.

Keywords: Herpetology, Restoration, Collections
<https://osf.io/csg8j/>

Green Pioneers, a Citizen Science Project at Meise Botanic Garden

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GS-02 General Session Poster Presentations

Green pioneers is a citizen science project on invasive plant specimens in Flanders (Belgium). It is a two year project funded by the Flemish Government with three main goals:

- Create awareness on invasive species, how can invasions be avoided and how can the negative impact be diminished.
- Make communication possible between citizens and scientist on biodiversity and invasive plant species.
- Augment the quality and quantity of data on invasive species in Flanders.

We will focus on three different groups:

- the young pioneers, by developing tools for STEM education,
- the online pioneers, through our online citizen science platform DoeDat.be, by helping us with the transcription of label information on herbarium specimens,
- and the visiteers, by inviting companies and working class people to help us in the collection and to inform them about invasive species.

In spring 2020 a BioBlitz will be organised in Meise Botanic Garden.

Keywords: citizen science, invasive species, doedat.be, bioblitz
<https://osf.io/ubxg9/>

Continued Care and Use of Specialized Legacy Collections Following Curator Retirement: A Case Study of the KU Invertebrate Zoology Collection

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GS-02 General Session Poster Presentations

Natural history curators commonly amass specialized research collections throughout their career. These collections often focus on a specific taxonomic group that is pertinent to the curator's research. Following curator retirement, however, there is the possibility for these specialized legacy collections to become

dormant and unutilized under certain conditions. Having such a collection that is undigitized, or is not under the care of a collection manager, can leave it inaccessible to other researchers and without proper care. In the Invertebrate Zoology Collection at the University of Kansas Biodiversity Institute, these risks became apparent following curator retirement. Although the collection is relatively small, with just over 2,000 lots, it contains an important assemblage primarily of hexacorallians (Cnidaria: Anthozoa) from world-wide localities. Through re-curation of the physical collection and associated data, we are working toward a greater potential for future use of the collection. When discussing the future of a legacy collection under these conditions, it is critical to assess where such a collection will serve its highest potential, and receive the best care. In order to prevent the disuse of collections following curator retirement, it is essential to consider the significance of digitization initiatives, collection managers, and long-range collection planning at the curator and institutional level.

Keywords: Legacy, Collections, Use
<https://osf.io/rs4cv/>

Notes from Nature: A Citizen Science Platform in Support of Biodiversity Research

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SY-04 Crowdsourcing Digitization: Partnerships, Platforms, And The Worldwide Engagement For Digitizing Biocollections (Wedigbio) Event.

Notes from Nature

(<http://www.notesfromnature.org>; NfN) is a

citizen science tool focused on public engagement and label transcription of natural history specimens. The project was developed collaboratively by biodiversity scientists, curators, and experts in citizen science, within the well-established Zooniverse platform. Notes from Nature launched in 2013 and has been successful by any measure in terms of public engagement and tasks completed. The primary focus of NfN has been transcription of label text from a wide variety of specimen types. While these tasks are extremely valuable in their own right, we have been exploring other ways that citizen scientists can help researchers utilize specimen data. In particular, we focus here on lessons learned using Notes from Nature to annotate phenological traits on specimens, along with having citizen scientists help build training datasets for object recognition and handwriting detection. We discuss next-step activities for the platform especially how to build in mechanisms to improve automated discovery of labels, label contents and even phenology, and improving this automated approach with human validation steps. These efforts will help position NfN as a truly next generation platform that continues to support the digitization community as well as the cadre of volunteers who are both the key reason for NfN's continuing success.

Keywords: citizen science, phenology, machine learning

<https://osf.io/4xfyb/>

How Do I Choose? Assessment of Fossil Preparation Techniques by Scanning Electron Microscopy

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GS-01 General Session Oral Presentations

Due to the nature of fossil remains, they require preparation to reveal the specimens from the matrix that holds them. Once fossils became of interest for science, the profession of fossil preparator became a need for both research and exhibition. The first attempts at preparation involved removing the matrix by any means necessary, even if it meant breaking the fossil and then reconstructing it. Since then, preparation techniques have evolved; mechanical and acid preparation require specific tools and training, and preservation of the specimens is a priority. In the last fifteen years, laser cleaning has been tested by preparators and conservators as a novel technique to remove matrix and consolidants. The goal of this work was to assess the safety of different techniques for the long-term preservation of fossils and for their future usefulness as research materials. Vertebrate fossil samples from the Cloverly Formation, WY were prepared using three different methods: mechanical preparation with an air scribe and pin vise, acid preparation with a 5% v/v solution of acetic acid, and laser preparation with a Nd:YAG (neodymium-doped yttrium aluminum garnet) 1064 nm laser system. Acid preparation requires the use of a coating for protection of the bones during digestion (Paraloid B67 in MEK), which degrades during exposure to the acid and must be removed after treatment. Removal was attempted with acetone and an Er:YAG (erbium-doped) 2940 nm laser system. All samples were analyzed using a scanning electron microscope in backscatter mode. The results suggest mechanical preparation is the technique that produces less damage if the preparator is properly trained. Acid preparation produces damage, but it can be minimized with proper training. Removal of matrix with the Nd:YAG laser was not successful, and the samples were damaged by the system. Acetone was the most efficient method for coating removal, as the B67 had not yet aged. Laser removal of coatings is

still being studied, but it is likely suitable for new and aged consolidants if previous testing is done to avoid damage on the specimens. This work shows all preparation techniques can produce damage if not done by trained professionals, highlighting the importance of skilled preparators in fossil collections.

Keywords: Fossil preparation, damage, SEM
<https://osf.io/nsp4h/>

Digitizing the Konecny Collection: Bringing a Local Fossil Collection to a Worldwide Audience

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SY-07 Interns And Young Professional Showcase (Poster Session)

James and Sylvia Konecny acquired an interest in fossil collecting after taking a mineral and rock identification class at Morton Arboretum in Lisle, Illinois. From there, they became dedicated visitors to the coal strip mines of the Mazon Creek area collecting an enormous assemblage of Pennsylvanian-age fossils. Despite the Konecnys' generosity in displaying their collection to community organizations and classes, the collection was not available to researchers.

As an intern at the Field Museum last summer, my job was to curate and digitize this collection. I renumbered the specimens, assigning them a Field Museum Paleobotany number. Next I photographed the specimen catalog cards and using low-angle lighting to bring out specimen details I photographed the fossils. I entered the data on the catalog cards into the database and created multimedia records for each photograph linked to the specimen records.

In the end, I photographed and digitized over 500 fossil plants from the Konecny Collection that are now available online for examination by researchers.

The internship gave me a broader understanding of both basic collection and digital curation work. I learned how to use professional-grade cameras to photograph fossils and how to produce conditions for the best photographs. In using EMu, I learned basic components of a professional museum database that will transfer to similar databases at other institutions. Challenges included keeping an accurate record of what specimens had been completed; tallying specimen progress in notebooks and improving computer file organization, in turn, improved my own organizational skills. The sheer amount of specimen curation I conducted gave me a better understanding of the Konecny Collection, including specimen morphology and a frame of reference for the collection locations. The independent nature of the internship enhanced my professional communication skills with my supervisor, whether it was asking quick questions on the telephone or taking the initiative to repair an accidentally broken fossil. My work with the Konecny Collection gave me a solid introduction to digital curation in a professional museum and an understanding of why collections need to be maintained and updated.

Keywords: Digital, Curation, Collection, Konecny
<https://osf.io/2yq3p/>

Everything Old Is New Again: Dilemmas, Contradictions and Differing Practices in the Redevelopment of Natural History Exhibitions.

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GS-01 General Session Oral Presentations

In the last 10 years, all 6 of Australia's major state museums have reimagined and reopened major, new, permanent natural history displays. Prior to this, old displays had been unchanged for many decades. Taxidermy had become a dirty word, dioramas we're out of fashion, specimens were tired and faded. In the intervening years most in house museum preparators had retired and not been replaced and when it came to redeveloping the exhibitions, design tended to be out sourced, often to architects.

For the past 7 years I have been intimately involved in this process as the taxidermist and senior preparator at the Queensland Museum. We opened "Wild State - Queensland's unique animals and their habitat" in September 2016 and have just opened our New discovery centre, March 2019 which includes over 1000 natural history specimens.

While I was stuffing kangaroos and other marsupials for the Queensland Museum, Narelle Jarry was in rural New South Wales taking up the position of curator and conservator overseeing the redevelopment of the Natural History Museum at the University of New England, Armidale. Narelle's work as a paper conservator had taken her around the world from the Metropolitan Museum of Modern Art in NY to MOMA Los Angeles to major Australian and regional libraries and museums, however this was her first foray into natural history museums and scientific collections.

Narelle and I met via a mutual friend and a yoga class. She needed someone to Taxidermy an endangered Southern Cassowary that was clogging up her freezer, and the friend new just

the girl. We have since collaborated on several projects, including the cassowary which is now happily installed.

In our presentation, Narelle and I would discuss our experience of these projects and some of the dilemmas, differing practices and contradictions thrown up in the course of our work redeveloping major natural history exhibitions. We have had some lively debates! Our topics for discussion include:

- What makes mounting a natural history display so different to other exhibitions.
- The role of the conservator in natural history exhibitions and the tendency to not involve them.
- The importance of preparators and taxidermists and what to do if they're no longer in house.
- Conservator vs preparator; differing approaches to natural history exhibitions.
- To conserve or to replace; when does a natural history specimen become an object?
- "But it has no data"- the non scientific value of natural history objects.
- Getting managers to understand lead times for acquiring and producing specimens for display.
- Museum Taxidermy and Australia's strict fauna protection laws.
- Health and safety, risk assessment and the forgotten risks of natural history.

Keywords: Taxidermy, conservation, exhibition preparation, differing practices
<https://osf.io/8jexu/>

A Captive Audience: Leveraging Museum Events for Formative and Summative Evaluation

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GS-01 General Session Oral Presentations

The University of Wisconsin Geology Museum (UWGM) is home to one of Wisconsin's most famous fossils, a historic mastodon skeleton containing bones from two sites roughly 50 kilometers apart. These bones were discovered in the late 1890's by children and were put on display at the UWGM in 1915. This specimen is beloved by museum visitors, featured in Wisconsin history textbooks, and is commemorated by a roadside historical marker in the southwestern part of the state.

Prior to 2015, this skeleton was known as the "Boaz Mastodon" named after the small Wisconsin town near where it was found. However, in preparation for celebrating our mastodon's 100th year on display, UWGM staff discovered that the skeleton was composed of bones from not one, but two historic mastodon finds. This changed the narrative of our museum's most iconic specimen which then required new interpretative signage, retraining our tour guides, and communicating the new story to the broader public.

As a small museum with limited staff, dedicating time towards conducting evaluations can be challenging. However, with the increased interest generated by local news stories, a pending anniversary celebration, and a vibrant outreach program – the UWGM was presented with varying audiences to participate in formative and summative evaluations for programming and exhibit development. Using mixed methods over the course of a year, UWGM staff conducted evaluation at library programs, museum special events containing future exhibit-mock-ups, and local science festivals. The results of these

efforts have helped UWGM staff hone in on potentially problematic interpretive language, better tailor programming to specific audiences, and enhance the development of a new exhibit containing Wisconsin's best collection of ice age megafauna.

Keywords: Museum Education, Evaluation, Outreach
<https://osf.io/fbkuz/>

Determining What Counts in Academia – Insights from a Small University Museum

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SY-06 Collecting Measures Of Success

At small museums affiliated with academic institutions, it is critical to regularly explain the importance of the museum collection for purposes of staff support, operational funding, and donor development. While it is also essential to track more standard metrics of collections use, these values do not always demonstrate the scientific significance of specimens, their historic or cultural importance, or the broader impact that is generated through their use.

At many higher education institutions, high impact teaching and learning practices are exceedingly valued by administrators and academic units are being asked to quantify their use of these methods. At the University of Wisconsin Geology Museum (UWGM), staff have been tracking not only the more typical metrics for a university museum but also attempt to measure and express the museum's high impact practices and how they further the mission of the University of Wisconsin and the Wisconsin Idea. Over the last five years, these methods have facilitated improved funding for staff support, greater recognition from college administrators, and increased institutional buy-in

from the museum's parent department, the Department of Geoscience. In addition to the metrics related to the UWGM's public outreach, non-conventional and high-impact uses of the collection are also documented in an effort to engender curiosity and interest among museum and university stakeholders. While the scientific contributions from a small university collection may not seem as significant when compared to larger institutions, the far-reaching benefits of their high impact practices may be a better expression of their importance to the communities in which they contribute.

Keywords: Metrics, High impact practices, Small collections
<https://osf.io/xhn97/>

Decoding Legalese: Intro to Copyright, Licenses, and Other Intellectual Property Issues for Non-Lawyers

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SY-02 Licensing And Rights Around Collections Data And Media

Mystified by the terms and conditions? Get a whirlwind tour of intellectual property laws affecting collections media and data, including:

- Copyright basics: know your (and others') rights
- The anatomy of a License Agreement
- Hot legal topics in rights and reproductions

Keywords: copyright, intellectual property, data sharing, licensing, creative commons, legal issues, laws
<https://osf.io/yuj5z/>

Salix Shoots and Falconidae Feathers: Anthropology Collections are Natural History Collections

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SY-08 Making The Case For Anthropology Collections

Anthropological collections document the ways in which humans have managed to adapt to and thrive in every environment on the planet. To many outside the discipline, these materials are pretty objects that belong in art museums; others view such collections as relics of colonial era practices in which white Westerners studied non-Western cultures as if they were studying a different species. Although both these views contain elements of truth, they miss the underlying reason that anthropological collections were historically, and are contemporarily, housed in natural history museums: we humans are part of the natural world.

Exemplifying cultural diversity and cultural continuity, anthropology collections are also repositories of biological and geological specimens, preserving data on the plants, animals and non-organic materials that were used to create them. Baskets made with *Salix* shoots and arrows fletched with Falconidae feathers contain information about the environment of the place and time they were created, the natural resources there and then available, and the ways in which *Homo sapiens* have interacted with the rest of the natural world. Using examples from the collection at the California Academy of Sciences, this talk will present examples of cultural diversity and cultural continuity, showing that anthropology collections are indeed natural history collections.

Keywords: anthropology, archaeological, ethnographic, collections, cultural diversity, cultural

continuity

<https://osf.io/47ejt/>

Good Enough? A Realistic Approach to Citizen Science Microfossil Sorting at La Brea Tar Pits and Museum

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GS-01 General Session Oral Presentations

In 2017, the La Brea Tar Pits and Museum, a research department of the Natural History Museum of Los Angeles County, began partnering with local teachers to incorporate microfossil sorting into their classroom curriculum as a participatory contribution to a food webs reconstruction project. Each year, hundreds of student citizen scientists identify plant and bone material from asphaltic matrix excavated on-site. This project has evolved as we have attempted to achieve a trifecta of outcomes: provide a unique and authentic educational opportunity; produce research-ready material through said educational opportunity; and create a project that is sustainable beyond the current funding cycle. While we concluded with positive progress on the first outcome, and have several fresh ideas for the third, it is the production of research-ready material that has been a challenge. Like other citizen science practitioners, we have grappled with developing a workflow wherein the validation and correction of participants' contributions is not unsustainably time-consuming.

However, a critical realization came from this process. Our student citizen science participants

collectively completed the task with an accuracy of +/-60% that of an experienced microfossil sorter, a seemingly dismal rate. When we examined the full suite of fossils categorized by the experienced sorters, we found that many of the items were fragmentary and therefore not identifiable beyond phylum. That is, the experienced sorters found more fossils than the students, but many of these fossils may not be suitable. This fact has several important implications for both the citizen science and the research components of this project and potentially others. First, it is possible that even imperfect citizen science contributions can be valuable. Complete fossils are easier for citizen scientists to identify, and even when fragmentary material is overlooked, it may not impact the overall outcome. Second, when we take a closer look at our fossiliferous matrix, only a very small portion is likely to ever be useful for research. When researchers and collections staff consider the time, space, and resources necessary to prepare specimens, it can be helpful to account for the actual amount of material likely to have value in research or collections applications.

Keywords: citizen science, microfossils, volunteer, education, paleontology
<https://osf.io/g3jzy/>

Five Years of Collaboratively Digging Bio: WeDigBio 2015-2019

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SY-04 Crowdsourcing Digitization: Partnerships, Platforms, And The Worldwide Engagement For Digitizing Biocollections (WeDigBio) Event.

WeDigBio, Worldwide Engagement for Digitizing Biocollections, traces its origins to a 2014 iDigBio hackathon. After several years of individuals contributing to online transcription platforms independent of each other, the time had come for the natural history collections community to organize around a unified, international, and social citizen science event. The 2015 WeDigBio pilot event was successful, thanks to nearly a year's worth of planning by dozens of individuals. In that year, and each year since, hundreds of citizen scientists attended WeDigBio events at museums, universities, and research centers, while thousands contributed online from over 50 countries. Not only has the community of citizen scientists proven to be a diverse and dedicated group, so too has the community of researchers, museum and collections staff, computer and information scientists, and educators who have embraced WeDigBio.

2019 marks the fifth year of WeDigBio and here we're taking the opportunity to reflect on and share what we've learned these last five years. Specifically, we trialed different methods of communicating and sharing during the event, strategies for recruitment and continued engagement, and how to make a robust contribution to the backlog of undigitized specimen information. We also found ourselves challenged with ways to tally transcription tasks across platforms with very different dataflows, create near-real time displays of completed task tallies and localities, and collaborating with other citizen science initiatives with their own workflows. Organizationally, we've grown in

some ways and contracted in others, yet our participation and contribution counts have remained fairly consistent.

Whether you're questioning whether citizen science transcription or annotation is useful for your collection, thinking of organizing a citizen science event, interested in participating in WeDigBio, or curious how to make global connections with other institutions, come hear about our successes, failures, and lessons learned. More than anything, we have lots of ideas for the future that we are excited to develop with you in the next five years.

Keywords: digitization, WeDigBio, citizen science, transcription
<https://osf.io/72aqd/>

Second Mass Digitisation Project for the Herbarium (BR) at the Meise Botanic Garden: Same Same but Different

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SY-05 Managing And Digitizing Large Collections

The Herbarium of Meise Botanic Garden is in the top 15 herbaria worldwide. The collection comprises some 4 million specimens, which are important for scientific research.

Digitisation of specimens includes imaging, transcription of label information and making these publically accessible online. As well as facilitating researchers' access to specimens, digitisation also brings new possibilities for analysing and discovering new data, as vast amounts of information from handwritten labels are databased.

In the DOE! project (Digitale Ontsluiting Erfgoedcollecties), funded by the Flemish Government, 1.2 million herbarium sheets from the African and Belgian collections were digitised. We have received additional funding to digitise a further 1.4 million specimens for the remaining vascular plants and macro-algae collections by October 2021. These include the historic collections of Von Martius and Van Heurck.

Carl Friedrich Philipp von Martius (1794 –1868) was a pioneering explorer whose expeditions led to the discovery of many species. He collated over 300 000 specimens, some of which were used to compile the first Flora of Brazil.

Henri Van Heurck (1838 – 1909) also collated herbarium specimens from all over the world, including specimens collected by Linnaeus.

Despite this being our second mass digitisation project, there are significant differences in our approach. This is partly due to lessons learned from the first project and partly to the nature of the collections themselves. The differences in the tendering process, preparation, workflow and data capture will be explained.

Making these specimens openly available online is valuable to scientific research as well as valorising of our collections.

Keywords: mass digitisation, herbarium, open data
<https://osf.io/6ju3s/>

Rehabilitation of the University of California Museum of Paleontology Miocene Amber Collection from Chiapas, Mexico

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GS-02 General Session Poster Presentations

The University of California Museum of Paleontology (UCMP) amber collection comprises ~2,000 inclusions of primarily insects from the State of Chiapas, Mexico. Frans (Frants Ferdinand) Blom (1893–1963), an archaeologist living in Chiapas, helped amass the collection during the 1950s through early 1960s. Though actively researched into the late 1970s, it received little attention until recently when UCMP joined the NSF-funded Fossil Insect Collaborative Thematic Collections Network in 2015 as a PEN (Partner to an Existing Network) to digitize UCMP's insect collections. During this two-year project the woefully substandard nature of the amber storage came to light. For 50+ years both type and non-type amber specimens were housed in microfossil cardboard slide mounts with tight-fitting plastic coverslips. Slides were arranged on flat metal trays shelved within wooden cabinets. However, as we discovered many of the specimens were actually taller than the slide's central well, and the coverslip literally had been forced over the top of them. Needless to say, due to the constant downward pressure applied to the upper surface of the amber pieces by the coverslip, and the drag on the pieces when the coverslip was taken out or slipped back in, many pieces incurred fine internal fractures and numerous surface scratches. Furthermore, yellowing of the cardboard indicated the non-archival quality of the paper used in their construction. Here we report progress related to our IMLS-funded preservation and digitization project to rehabilitate the UCMP amber collection using clear epoxy resin to stabilize the extremely fragile specimens. Embedding in resin will once again allow the UCMP inclusions to be physically handled for detailed imaging, research use, education and public outreach activities

without fear of causing further damage. Through our IMLS digitization efforts we will also be providing downloadable pdfs of the rich collection of amber archive documents, which are currently being cataloged and uploaded to UC Berkeley's Docubase database (<https://docubase.berkeley.edu/>), where ultimately they will be hyperlinked to the UCMP's online Amber Files Archon finding aid (<http://ucmparchives.berkeley.edu>) making them accessible to the public.

Keywords: amber, resin embedding, preservation

<https://osf.io/tp5fa/>

Utilising the Salting out Method to Distinguish between Common Fluid Preservatives

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GS-01 General Session Oral Presentations

Many natural history collections contain specimens preserved in fluid. Understanding the type of fluid used to preserve a specimen is vital to understanding the way in which a specimen may degrade. It is also important from a health and safety perspective, due to the known hazards associated with fluid preservatives. The type of fluid preservative used is often not documented, and unknown fluids can be difficult to identify. There are several published methods to determine fluid type, but these can be costly, time consuming and/or require large fluid volumes.

The method discussed in this presentation builds upon the salting out test published by Mayfield (2013). Salting out is the separation of an organic phase (e.g. alcohol) from an aqueous phase (water) through the addition of salts. The method that has been developed utilises the salts potassium carbonate (K_2CO_3) and sodium chloride (NaCl) to distinguish between the three most commonly used fluid preservatives: ethanol; isopropanol and formalin. The test is quick, simple and only requires a small fluid sample of 2 - 4 mL

The method can distinguish aqueous solutions (formalin) from varying concentrations of alcohol and water solutions. The test can determine alcohols from formalin using K_2CO_3 and can indicate the approximate alcohol concentration of isopropanol or ethanol. Ethanol and isopropanol can then be distinguished using NaCl, which will only salt out isopropanol. Bromothymol blue indicator is used to distinguish layer separation in the fluid.

Tests were initially conducted on known fluid preservatives and alcohol concentrations, then on samples from collections. Direct analysis in real time mass spectrometry (DART-MS) was used to confirm the results of the salting out tests and highlight limitations of the simpler method. The test supplies and equipment are relatively inexpensive compared to other methods of distinguishing between fluid types, which makes the method an accessible and affordable way to determine which of the common fluid preservatives has been used to preserve a specimen.

Keywords: Fluid preservative, salting out, alcohol, formalin, DART-MS
<https://osf.io/ua489/>

Methods of Determining Formalin Concentration in Fluid Preservatives

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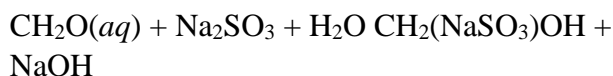
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GS-02 General Session Poster Presentations

Formalin (3.7% - 4% aqueous formaldehyde) is commonly used as a fixative to prevent post mortem changes in the tissues of a specimen. The specimen is then either maintained in formalin or transferred to another fluid preservative, such as ethanol or isopropanol, for long term preservation. Residual formalin often remains in the preservation fluid. As formalin is a known carcinogen, it is important to know the concentration present in preservation fluids.

A titration method has been developed to determine and calculate formalin concentration. An adjustable, repeating pipet and a digital titrator with calibrated analyte solution allow for the rapid determination of formalin concentrations in small samples (=1 mL). The titration method relies on titration of hydroxide released when a solution of sodium sulfite (Na_2SO_3) is reacted with a formalin solution to form a formaldehyde-sulfite addition compound and free hydroxide according to the reaction:



This method of titration is compared with three commercially available methods of determining formaldehyde and formalin concentration: two brands of formaldehyde test strips, MQuant™ (EMD Millipore Corp) and Quantofix® (Machery-Nagel GmbH); and a drop count titration test kit (Hach® Formaldehyde Test Kit – Model FM-1).

A comparison and evaluation is made on the effectiveness of each method in determining the concentration of formalin in preservation fluids.

Keywords: fluid preservation, formalin, formaldehyde, titration
<https://osf.io/pwnym/>

Reading the Layers - Destructive Sampling of Marine Mammal Specimens at the California Academy of Sciences.

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SY-14 Best Practices in Destructive Sampling: Methods for Limiting Specimen Information Loss While Maximizing Research Potential

Marine mammal collections are invaluable resources for specimen-based research that provide information on life history of individuals, stock delineations and population status, as well as the biodiversity and health of the oceans. Destructive sampling of tissue, blubber, baleen, teeth, and ear plugs of cetaceans adds valuable data to a scientific collection. These data, recovered from specimens archived from dead stranded marine mammals, allow researchers to understand more about these difficult to study animals, including age estimates, feeding locations, contaminant loads, and stress levels.

The California Academy of Sciences holds a large collection of marine mammal specimens, including the world's largest collections of California sea lions (*Zalophus californianus*) and Southern sea otters (*Enhydra lutris nereis*), various other pinniped collections, and a substantial number of cetacean specimens. In addition to traditional taxonomic and life history studies, these collections are available for the

application of new technologies and advanced research methods, including destructive sampling for hormone, contaminant, DNA, and stable isotope analyses. As stewards of the collection, we carefully review each sampling request, weighing the pros and cons of the proposed methods, the damage to the specimen, and the inherent value of the resulting data.

This presentation will include a summary of several methods of destructive sampling of marine mammal specimens and the criteria for reviewing sampling requests at the California Academy of Sciences. It will also include a brief overview of destructive sampling protocols for bird specimens in the collection as well as examples of unfortunate destructive sampling cases from the past.

Keywords: marine mammals, destructive sampling, new technologies
<https://osf.io/mxpng/>

Experiential Learning through Natural History Collections for Undergraduates

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GS-01 General Session Oral Presentations

Museums serve many extremely important roles in society, from research to education. University-based museums function as scientific institutions with the ability to provide undergraduate students with opportunities to not only gain knowledge about the natural world but develop skills for future careers. During my tenure as a Master's student in the Biology department at the University of Florida (UF) I created an Introduction to Natural History Course which allowed UF to further harness the

power of the Florida Museum of Natural History to enrich students' academic experience.

The course was an exploration of careers in museum-based research. During the course students were introduced to alternative career paths from pre-professional fields, through observation of and immersion into the roles of museum collections personnel. Students' individual projects within the collections provided them with research and curatorial experience which also contributed to advances in scientific knowledge.

In this presentation, will share insights on my preliminary findings thus far. I will also speak about my goals moving forward to further develop the course at UF and as a research project as a Ph.D. student. Using formative and summative assessments, as well as reflective exercises my research project will evaluate one important audience the museum aims to inspire to care about life on earth-- the next generation of scientists and policy makers.

Keywords: Experiential, Projects, Undergraduates
<https://osf.io/tbzc/>

Entomology Backlog Flats Digitization Project - California Academy of Sciences

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GS-02 General Session Poster Presentations

The backlog flats collection at the California Academy of Sciences contains over 6,000 backlog "flats" of dried insects from around the world, collected from the early 20th century to the present. This project allowed for a collection to be accessible through Flickr and Google Sheets (free and open source) to researchers

globally, while also having the potential to be studied, impact evolutionary biology research, as well as had the potential for new species to be described from the available images. Further, this project can allow for the natural history collection community to have more collaboration and communication between each other. The simple workflow for this project included: label flats with unique numbers, prepare box for imaging (moving labels, add scale bar, color target), capture image (with lightbox or SLR camera with studio lights) and name in chronological order, edit white balance in batches, transfer images to internal folder, upload image to Flickr in locality specific folder, and enter label data (collector, location, date, method) to Google Sheet. This is a low budget alternative to digitization, and especially for collections of entomology flats, other relatively flat natural history collections, and backlog collections that otherwise would not be digitized, in case of disaster, loss, and unknown interest in specimens from all over the world (among other curiosities).

Keywords: Digitization, entomology, open-source, ecology and evolutionary biology
<https://osf.io/35gju/>

The Role of Earth Science Collections within Biodiversity Research

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GS-02 General Session Poster Presentations

Earth Science collections, like Life Science collections, have an important role in biodiversity research as they provide evidence for the evolutionary history of organisms and the

environment. Likewise, they help to understand the impacts of natural hazards, disasters, and environmental and climate change.

In our conference contribution we would like to present and discuss the importance of Earth Science collections in biodiversity research and other cross-disciplinary subjects. The topic is related to the implementation of metadata standards, publication of collection data via data portals, tools for mapping the data and conducting quality checks as requirements for effective research based on collections.

The presentation has a special focus on the following topics:

- The role and implementation of fossil taxa in the taxonomic backbone (e.g. Catalogue of Life) and the role of geochemical data in related platforms.
- Defining minimal, optimal and full requirements for data records in digitised Earth Science collections.
- Implementation and usage of existing metadata standards and controlled vocabularies for Earth Science collections.
- Data portals, search and presentation platforms for Earth Science collections access, research and outreach.

Related topics will be also addressed as special symposium during the conference Biodiversity Next in Leiden, Netherlands, in October 2019.

Keywords: Earth Science collections, biodiversity, metadata standards, data mapping, data portals, virtual access.

<https://osf.io/ehmuk/>

We're Hosed: Managing Risk During Early Planning

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GS-01 General Session Oral Presentations

Because the museum building serves as a tool in preventive conservation, its maintenance and repair are critical to collection care. Capital projects are then necessary for the proper operation of the building, but the associated design and construction processes introduce risk to the museum. Design allocates space and other resources; construction then cements these changes in ways that often interrupt museum operations over time. What are the problems of most potential destruction to building contents, and where can planning make a world of difference in reducing risk?

This oral presentation presents an overview of the initial planning process, using a critical path schedule as an introduction for people who've not participated in a capital project. Discussion will identify how early decisions reverberate throughout the project and constrain important considerations such as project scope and budget. Risk changes as plans become more complete, so the participation of museum professionals early and consistently helps ensure a truly successful project that assists stakeholders including those responsible for collection care. The presenters will focus on the development of early cost models to show their impact over many years. Budgets quickly become hardfast, and understanding their composition and meaning will help participants become more effective participants along the way.

Keywords: risk, building, design, construction
<https://osf.io/qk7cf/>

Q?rius about Engaging Students in the Herbarium: An after School Botany Program

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GS-02 General Session Poster Presentations

Q?rius is an interactive science education center open to the public. It is located at the Smithsonian Institution, National Museum of Natural History in Washington, DC. The center offers hands-on learning opportunities primarily geared towards teenagers. During normal operating business hours, all ages are encouraged to handle specimens available on display. Q?rius also offers a uniquely crafted after school program for high school students. Students attend from various schools within the DC Metro area.

In 2018, the Department of Botany was selected to create three courses for the after school program. Gabriel Johnson, LAB Botany Technician, met with the Q?rius education team to discuss possible curriculum ideas. They formulated questions and then incorporated the use of the herbarium, cultivated plants, SEM and molecular lab equipment to answer their crafted botanical questions. Each course focused on a particular plant family or group. The first course was one day a week for five weeks and featured the crystals in Araceae. The second course was a one-day workshop, teaching students about identifying Lamiaceae. Lastly, Pteridophytes were featured one day a week for three weeks. All three courses followed a similar structure.

During the first day the students were introduced to the herbarium via an in-depth tour. The tour featured the focus plant group as well as the importance for maintaining herbaria for future research. The students were given a field notebook and information about how to take quality field data. Depending on the season and weather, the students were lead into the garden surrounding the Natural History building or given a potted plant to examine. They learned how to properly take cuttings and press their sample using a plant press. The instructor explained the drying process and the students

were given pre-dried plant specimens to mount using archival museum quality techniques. During the next session, a scientist specializing in the particular plant group would give a talk. The students were able to interact face to face with a working scientist. The scientist explained the scientific method and why the methods are important for their research. During the next session, the students were taught how to use dichotomous keys. Students were split into groups with an aid. The aids assisted with teaching students how to read keys and explained botanical terminology. The last two sessions focused on molecular lab techniques. Students learned about morphological analysis by using a variety of microscopes. Then the students would be taught how to extract DNA from their focus plants. The next session would continue with the DNA analysis and the instructor would explain the results. At the end of the last session the students would be able to showcase their work; herbarium specimen, field notebook, DNA analysis and any other accompanying documents to their parents/guardians to explain what they learned. Students were asked to provide their feedback about the course to the Q?rius educators.

Overall, these after school programs have been successful and the students have responded positively to the curriculum. It is a great way to introduce young people to a specific discipline in a short amount of time. This poster will provide in-depth detail about each session and how the lessons were developed.

Keywords: Herbarium, Botany, High School Programs

<https://osf.io/f3xg4/>

Mass Digitization of a Historic Histological Slide Collection: Challenges and Insights

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SY-05 Managing And Digitizing Large Collections

Microscopic preparations are part of many natural history collections, be it histological slides, insect genitalia or whole mounts of minute organisms. Over time, a host of collection items has been produced for microscopic analysis throughout all fields of natural history, medicine and beyond. However, especially stained histological slides are prone to fading and other forms of aging processes, which result in a slow decay of the information held in these objects. One way to preserve this information is digitization of the slides. Due to the large numbers of objects involved – the serial sections of one embryo may easily count dozens of slides – this is both time consuming and produces big data. Mass digitization of historic histological slides involving unusual slide formats and fading stains thus is a challenge that needs careful planning. Embedded in an international co-operation (Digital Embryology Consortium) to digitize part of the slides in the Embryological Collection housed at the Museum für Naturkunde in Berlin, Germany, a workflow for managing object handling and slide scanning was developed to optimise for throughput of slides. Besides scanning objects in high demand for future use, this project provides valuable experience and first-hand information for planning future slide digitization activities at the Museum für Naturkunde, Berlin.

Keywords: histological slide, embryological collection, digitization, workflow

<https://osf.io/gdwb9/>

Flexing Mussels: Developing a Crowd-Sourced Workflow to Explore Morphological Variations in Freshwater Mussels Using the Milwaukee Public Museum Collections

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GS-02 General Session Poster Presentations

Biological conservation relies upon understanding historical conditions, however human influence is pervasive and establishing reference conditions is a common challenge. As organisms grow and develop, many produce indelible body parts that remain intact after their death. For example, the growth and development of plants affects tree rings and activity patterns affect the bone structure of vertebrates, leaving a record of the life of that organism. The shells of freshwater mussels are a prime example of such remains. Mussel shell structure is influenced by the substrate in which they live and water movement patterns around them, for example whether they lived in exposed or sheltered parts of a lake. Likewise, mussel community composition and shell shapes within species vary over the course of rivers from headwaters to mainstems. Records of this variation are captured by vouchers in museums. Museums play an essential role in maintaining the integrity of, cataloging and organizing biological specimens. The Milwaukee Public Museum has positioned itself to become a cornerstone of such essential

specimens in Wisconsin. We developed protocols for photographing the mussels, processing images and assuring the quality of the data collected. Each mussel shell was digitally photographed using a workflow that was developed to ensure that high-quality, consistent and size-referenced photographs were taken. We also developed a workflow on the citizen science platform, Zooniverse, to allow volunteers to capture data from the digitization efforts. We have uploaded images from an early museum expedition (1908-1911), a statewide survey (1970's) and will soon be adding images from a recent state-wide survey. We created automatic, repeatable quality assurance and quality control protocols, applied them to the data collected and compared these data to data that were hand-collected by calipers. Although spurious data were collected by volunteers, digital data that passed quality assurance measures reliably reflected hand-collected data.

Keywords: citizen science, mussels, morphology
<https://osf.io/bfdg5/>

STASHc.com, A Platform for Collaboration: Website Tour

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SY-10 Storage Techniques For Art, Science, And History Collections (STASH) Preventive Conservation And Storage: STASH Flash II

The STASHc.com website catalogs storage support solutions for cultural property, creating an online resource that gives museum professionals from institutions of all types and sizes access to a bank of ideas designed to provide better collections care. The site can be

used to find solutions to recurrent storage problems, prompt the development of new ideas, or browse entries to view what others have done to resolve their own storage conundrums.

The site expands upon the 1992 Society for the Preservation of Natural History Collections (SPNHC) volume *Storage of Natural History Collections: Ideas and Practical Solutions*, edited by Carolyn L. Rose and Amparo R. De Torres. The Foundation for the American Institute for Conservation (FAIC) launched STASHc.com in 2014 as part of a cluster of collections care initiatives targeted at addressing concerns shared by collecting institutions. The site was created with a grant from the Samuel H. Kress Foundation and is housed online within the suite of Conservation Online (CoOL) resources. Entries are vetted by an editorial committee with members from a wide range of professional organizations including conservators, collection managers, registrars, mountmakers, technicians, librarian and archivists.

Unlike some other aspects of preventive care, there are few right or wrong answers in creating storage supports, and a successful solution is the result of numerous choices regarding materials, techniques, time and skill. The site crowdsources community driven solutions and creates a platform for connections and commentary between collecting institutions, individuals involved in collections care, and preservation vendors.

This presentation will give an overview of the STASHc.com website's structure and features, its development, and efforts to create a community of users. The site's editorial process will be discussed along with information on how to contribute solutions. The Editorial Committee is eager to increase the articles and activity presented on the site with assistance from the

preservation community worldwide.

Keywords: STASHc, storage solutions, techniques
<https://osf.io/k8fau/>

Rabor Wildlife Collection: Today's Record for Understanding Remarkable Biodiversity of the Philippine Islands

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GS-01 General Session Oral Presentations

Dr. Dioscoro S. Rabor is considered as the Father of Philippine Wildlife because of his incomparable contribution to knowledge and understanding of Philippine biodiversity. During his more than 20 years of field research, he led as much as 50 biodiversity expeditions involving the major Philippine islands. From this fieldwork, he was able to collect more than 60,000 specimens, which were deposited in various museums in the Philippines and the USA. In the Philippines, a large portion, consisting of more than 10,000 bird and 4,300 mammal specimens, are deposited at the UPLB Museum of Natural History. These specimens are significant material for taxonomic and ecological studies. Some specimens are used as teaching material in Wildlife Biology classes. Several researchers and students have utilized the specimens in identifying species limits in birds. With the advent of technologies in molecular biology, museum specimens are also significant sources of historical DNA for sequencing and phylogenetic analyses. This is extremely important for resolving taxonomic issues on threatened or rare species since collecting of these species is highly restricted by law. The Museum continues to

uphold these collections to complement current efforts in understanding and conserving the rich biological diversity of the Philippines.

Keywords: Philippines, Wildlife, Heritage
<https://osf.io/qbdhg/>

Advanced Collection Management Using Arctos: Publications and Projects Demonstrate a Collection's Impact.

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DC-01 DemoCamp

New knowledge described in scientific publications is the ultimate product of museum specimen use. Arctos, an online museum collection management solution, allows for publications to be linked to the specific specimens that they reference. The impact of any single specimen, accession, loan, or collection as a whole can then be quantified in terms of publications produced or specimens cited. Publications citing voucher specimens are displayed in the Arctos specimen record, allowing future researchers and curators to see which analyses have been done previously on specimens of interest, thereby eliminating redundant subsampling or handling. Arctos "projects" allow for the aggregation of data from accessions, loans, publications, and specimen records into a single-page display of the impact that a curator-defined "project" has produced. Arctos projects can be very useful in reporting, and in many cases may replace a written report prepared for granting agencies, institutional departments, or government agencies (NPS,

USFWS, etc.). We will demonstrate how publications are entered, specimens are linked through citations, and how projects are built to show a collection's impact within Arctos.

Keywords: Arctos, publications, demonstration, collection impact
<https://osf.io/srx9m/>

Networks of Species, Data and People

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SY-03 Interconnectedness Of Data

Specimen digitization is often conceptualized as a set of workflows that leads to digital products that can ultimately be discovered by others. Along those workflows, and for the sake of often supporting discoverability, some of the most valuable content that can support the broadest research utility are often left hidden in the specimens and the published data records themselves. This includes rich information on species interactions, life history and morphometric data. The first generation of digitization has critically built needed digital resources but the next wave of digitization will move away from portals and platforms dispensing narrowly formatted data. Instead, the data resources will be more interactive, more three-dimensional and will bring together networks of data connected via stronger semantic approaches, denser people networks, computer vision automation. Critically, these new approaches also break down artificial barriers and silos allowing for new data integration needed for understanding biodiversity response to environmental change. Here I provide examples focusing on work to uncover already digitized but hidden information about mammal and bird body size and other species traits, plant

flowering phenology, and species interactions. These examples showcase the key theme of “interconnectedness” and how data digitization can support a better thriving ecosystem of data resources and tools.

Keywords: species interactions, species traits, digitization, interconnected data resources, linked open data
<https://osf.io/8fb3r/>

Teaching Collections of T. C. Chamberlin at the Whitewater Normal School (1869-1873).

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GS-01 General Session Oral Presentations

Thomas Chrowder Chamberlin (TCC) was one of the most influential research geologists of the 19th century, publishing over 250 papers on Paleozoic stratigraphy, glacial geology, scientific philosophy, cosmology, and more. TCC founded the Geology Department at the University of Chicago, and served as President of the University of Wisconsin-Madison, Head of the Wisconsin Geological Survey, Professor at Beloit College and Director of the Glacial Division of the U. S. Geological Survey. Prior to all of those, TCC's very first professional position was as Professor of Natural Sciences from 1869 to 1873 at the Whitewater Normal School (today, the University of Wisconsin-Whitewater). Despite a catastrophic fire in 1970, at least 130 of TCC's teaching collection of fossils survived, many of which still retain the handwritten, TCC-signed labels. While none of the specimens could be called museum-quality, they have value as historical documents of the early academic life of an important researcher, and of how paleontology and stratigraphy were taught at a small, rural, teacher prep school just a

few years after recognition of Darwin/Wallace natural selection. After display at UW-Whitewater as part of a sesquicentennial celebration of the arrival of TCC, the specimens will be donated to the Milwaukee Public Museum.

Keywords: Chamberlin, Whitewater, Teaching
<https://osf.io/tujdv/>

Clean, Bright and Waterproof: Custom Tyvek® Covers

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SY-10 Storage Techniques For Art, Science, And History Collections (STASH) Preventive Conservation And Storage: STASH Flash II

Before the introduction of Tyvek® as a museum material, covers for over-sized objects were made from polyethylene sheeting. In 1985, Joan Gardner, conservator at the Carnegie Museum of Natural History [1978-1999] had rolling platforms built to accommodate oversized objects, with removable wooden frames to protect the objects from the plastic covers. Gardner's design was published in *Storage of Natural History Collections: Ideas and Practical Solutions* [1992]. Science Museum of Minnesota Conservator Gretchen Anderson adapted the dust covers and brought these and other improvements to CMNH in 2009.

Early covers were initially hand-sewn, & later heat-sealed to shape. Time and light caused deterioration of the plastic, so we're now making new covers using Tyvek®, which sews beautifully. "French seams" create a stiffened

faux-framework for smaller objects without external frames.

Keywords: Oversized Object, Tyvek®, Rolling Platforms, Covers
<https://osf.io/y49wg/>

Establishing the Natural History Collections Club Network: Engaging Undergraduate Students in Natural History Collections

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SY-15 Broadening Participation of Students in Biodiversity Collections through a Network of Student Clubs

In February of 2013 nine students at Arkansas State University came together to form the Natural History Collections Curation Club (NHC3). The students of the club made it their goal to restore the collections by dedicating their time and helping to secure funding. These efforts have resulted in funding from the Dean of the College of Sciences and Mathematics for a part-time student worker in the collections, supplies for several projects including jars and ethanol for restoring the fish collections and materials to create two large specimen mounts, and trips to visit several natural history museums. The NHC3 has helped A-State become recognized in the collections field where it was previously unknown. The club has also helped other universities increase student interest and involvement in collections. Now several other universities have active natural history collections clubs as a result of the A-State model and have worked together to create a network. Our goal is to use the Natural History Collections Club Network (NHCCN) as a platform to motivate students across the United States to become more involved in university specimen collections.

Keywords: Clubs, Undergraduate Involvement, NHCCN

<https://osf.io/56vku/>

A Plant Said to Make Lions and Tigers Docile*

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SY-03 Interconnectedness Of Data

1731 was an exceptional year for British horticulture, and, as has recently been discovered, a very exciting year for the UK's Royal Horticultural Society (RHS), in spite of it not being formed until 1804.

By unravelling the exceptional story of a single lavender specimen now housed in the RHS's herbarium, whose provenance, although steeped in gardening history and playing a tiny role in the events of that year, was lost for almost 300 years, we are able to demonstrate the importance of interconnectedness of data, collections and relationships both then and now.

In 1731 Philip Miller's seminal publication, *The Gardeners Dictionary: containing the methods of cultivating and improving the Kitchen, Fruit and Flower Garden, as also the Physic Garden, Wilderness, Conservatory, and Vineyard* was printed. Miller wrote the book whilst in the employ of the Chelsea Physic Garden, London, UK. Through a chance remark in an email from one of the curators at the Natural History Museum, London, and subsequent research and exchanges with curators at the Cambridge University herbarium, the Chelsea Physic Garden and the Worshipful Society of Apothecaries, we have discovered that the lavender specimen actually came from the

Chelsea Physic Garden and was created in the year Miller's book was published.

Similar to the butterfly effect, one tiny question has resulted in an explosion of information on the lavender and other specimens/plant collectors being shared between curators and their collections.

Reference:

*Baker, Margaret (2011), *Discovering the Folklore of Plants*, 3rd edition, Oxford: Shire Classics.

Keywords: lavender, herbarium, collection, horticulture, eighteenth century

<https://osf.io/p2hrg/>

Robert Brown - Disentangling the History of Specimens of a Scottish Explorer in the Herbarium of the Royal Botanic Garden Edinburgh

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GS-01 General Session Oral Presentations

Born in Montrose, Scotland in 1773, Robert Brown made his mark as a scientist in botany and palaeobotany. He is most famously known for his discovery of Brownian motion which came through his use of microscopy to investigate pollen grains in water. Robert Brown is also one of the most significant collectors of plants in Australia. Arriving in Australia in 1801 Brown and his colleagues then spent the next four years travelling around Australia making substantial numbers of herbarium, seed, mineral and zoological collections.

The importance of Brown's collections has long been recognised, but there are difficulties in the

correct recognition and selection of the type specimens within the collection. This has partly come about by the existence of several sets of specimens in various institutes of which only some have been annotated with the number series of JJ Bennett who was Brown's executor. There is a real need to make Robert Brown's specimens available to taxonomists in order to resolve the considerable confusion over the typification and and provide other international herbaria holding Brown specimens a key to unlocking their collections.

A preliminary survey of the specimens looking particularly at differences in labels, label information and handwriting has produced some interesting results. This indicates that there are potentially four or more sets or partial sets of Robert Brown specimens held at RBGE. Whilst carrying out the preliminary analyses of the Robert Brown specimens at RBGE we found that there are an astonishingly high percentage of type specimens – a quarter of the total number of specimens collected by him and held at RBGE are types.

This presentation will describe the work carried out at RBGE to disentangle the history of these specimens and to open-up the story to the public, using modern digital storytelling techniques.

Keywords: herbarium, history, collections

<https://osf.io/bu8sf/>

A Tale of Natural History Collections Education at Virginia Tech

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SY-15 Broadening Participation of Students in
Biodiversity Collections through a Network of Student
Clubs

The Natural History Collections Club (NHCC) was founded at Virginia Tech during the fall of 2017 with assistance from the Natural History Collections Club Network. The primary purpose of the club is to increase student awareness of natural history collections on and around campus. After two years of operation, the NHCC has met that goal with considerable success through collection tours, workshops, volunteer activities, outreach, and social events. As proof of that success, many members have gone on to conduct research in club-associated collections and participate in internships at collections around the country. Furthermore, the NHCC has served as a valuable avenue for increasing collaboration among curators on campus. This growing interest in collections at Virginia Tech has even produced a natural history collections and curation course for the spring of 2019. Students in the course learned collection principles and curation techniques, then worked with campus curators to complete collections-based projects. In just two years, the NHCC has progressed from uncertain beginnings to transforming the culture of campus collections and invigorating collection use in courses. We hope that other institutions can learn from our experiences and start their own natural history collections movements.

Keywords: education, teaching, outreach,
volunteering, clubs

<https://osf.io/82me6/>

Understanding the Mechanisms of Pyrite Decay

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GS-01 General Session Oral Presentations

Pyrite disease/decay/oxidation is widely recognized as an inherent vice with negative outcomes in natural history collections. Without treatment or intervention, specimens can be completely transformed to dust. Historically, some mitigation recommendations have proven to be effective while others fail to meet the standards of scientific rigor. Controlling pyrite decay on fossil specimens by reducing relative humidity and oxygen has proven to be effective. However, application of a barrier compound directly on the specimen is inadequate to stop or control decay. Decay will proceed from the inside-out, causing expansion and erupting from within.

In order to approach this complicated problem, a threefold strategy is outlined and explored here. First, know the components and their molecular characteristics. Specimen deterioration attributed to pyrite can be caused by marcasite, a polymorph of pyrite known to be much less stable. A single specimen can contain pyrite, marcasite or both pyrite and marcasite simultaneously. The presence of pyrite (or marcasite) is not the only factor in determining the stability of a specimen in the long term. Associated minerals can play a huge roll in both the relative stability of a specimen and the rate at which it will decay. It has been noted that the presence of specific clays in the matrix surrounding fossil material will have an influence on the stability of any ferrous sulfate present. Research conducted by Dr. Chris Tacker of the North Carolina Museum of Natural Sciences found that Kaolinite and Halloysite are two major contributing factors to the instability of a specimen with incorporated Pyrite.

Second, deploy this information and explore the literature not only based on natural history collections, but include disciplines across the academic spectrum. In the industrial sector,

pyrite oxidation is an intensely studied phenomenon due to the economic and environmental impact of Acid Mine Drainage (AMD) – contaminated water runoff from mining operations. Understanding AMD, sulfur contamination, and pyrite oxidation is critical to environmental protection and minimizing water contamination and therefore has produced a wide array scientific studies with potentially relevant data. One factor that has been shown to determine the formation of either marcasite or pyrite during diagenesis is the pH of moisture in the environment. Specialized chemical analysis incorporates more complex chemical redox reactions which provides important information on decay contagion.

Understanding and applying these two factors to natural history collections is the third and final strategy synthesizing solutions for natural history collections affected by pyrite decay. Important conclusions from implementing this strategy can then be applied to properly handling newly acquired collections, preventing contamination, and assessing budgetary needs.

This project was supported by a National Science Foundation Collections in Support of Biological Research Grant (NSF CSBR award 1560871).

Keywords: Pyrite, decay, mitigation

<https://osf.io/4h6bf/>

Increasing Discoverability of Natural History Genomic Resources through the Arctos / GGBN Collaboration

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GS-02 General Session Poster Presentations

Arctos (arctosdb.org) is an affordable, collaborative collection management solution serving global data on over 3.5 million biodiversity and cultural records and 775,000 media objects from more than 158 collections and serves as the backbone for Harvard's MCZBase. Arctos is also a community of museum professionals who collaborate on best practices, trainings, and webinars, and who work together to improve data richness and expand functionality. In 2017, the MSB, MVZ, and UAM received funding from the Global Genome Biodiversity Network (GGBN) to standardize tissue sample and quality vocabulary, provide public information on permits, implement parent-child relationships between tissues and subsamples, and develop a migration pathway to GGBN. The results of the first test data submitted to the GGBN pipeline showed that there were additional integration issues that required programming support and consultation in order to publish Arctos collections data through GGBN. Specifically, Arctos employs an event-based model which enables some records to have multiple occurrences. For example, multiple mark/recapture collecting events of a single individual result in parts collected from different places and dates associated with a

single catalog number. The interpretation of what constitutes an occurrence differs between GGBN and GBIF, and consequently, the Arctos resources for GGBN and GBIF must be published separately. On resolution of these issues in spring 2019, the Denver Museum of Nature & Science--currently a GGBN associate member--will be joining as the fourth Arctos institution serving data to GGBN. In addition, the Arctos community will provide GGBN with existing host-parasite use cases, which are well developed in Arctos, and will share the developing model for environmental DNA. A standardized form to submit Arctos data directly to GenBank has been developed and is in process of being tested with community feedback.

Keywords: Discoverability, host-parasite, environmental DNA

<https://osf.io/rxdwc/>

Efficient and Novice-Proof Physical Tracking of Cultural and Biological Collections Using Machine Readable Barcodes

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SY-10 Storage Techniques For Art, Science, And History Collections (STASH) Preventive Conservation And Storage: STASH Flash II

The University of Alaska Museum of the North (UAMN) uses the online museum collection management solution Arctos to maintain collection object data. Arctos manages over 3.5 million object and specimen records for 29 institutions as well as another 2 million records in Harvard's MCZBase. Digitization of data

associated with collection objects has reduced transcription error, standardized data input, and increased accessibility of our collections. While most institutions have found an efficient way to track data associated with objects, physical tracking of these objects has lagged. Both cultural and biological collections at UAMN have taken advantage of the sophisticated object-tracking capabilities in Arctos, which are as-yet unavailable in other commercial and freeware collections management systems. This provides us with an established system at UAMN that has been fine-tuned over a decade of use. The object-tracking feature uses barcodes, a string of unique characters that are machine readable by barcode readers. The barcodes are attached to all objects: from rooms, cases, specimen trays, and down to the object label itself. Arctos then creates a hierarchical map of an object's physical location starting with the place in the building down to the position in the tray, making it easy to pinpoint the exact location of an object. Arctos can move objects in bulk, for example scanning a tray into a new case in seconds, updating locations of all objects in that tray. When researchers and visitors request access to items in these collections, staff can reliably pinpoint the exact location of the object. Objects examined can be quickly entered into a loan record using the barcode, which allows us to more effectively track object usage. This system is more efficient and introduces fewer opportunities for human error than other systems.

Keywords: object-tracking, barcodes

<https://osf.io/kymdq/>

Upgrades to the University of Alaska Museum's Genomic Resources Facility and a Novel Space-Saving Cryotube Design

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GS-02 General Session Poster Presentations

The University of Alaska Museum (UAM) has maintained a frozen tissue collection for nearly three decades. Samples were originally housed in ultracold freezers, but mechanical failures, power outages, a lack of responsiveness by campus emergency services, and the potentially disastrous synergism among these posed a real threat to this irreplaceable and increasingly useful resource. With funding from NSF, UAM's Genomic Resources (GR) collection was transferred from mechanical freezers to liquid nitrogen (LN2) between 2008 and 2016, and an in-house LN2 production facility was installed. LN2 is widely considered the gold standard for the permanent preservation of frozen organic samples, with the added benefits of substantial energy savings and greater space efficiency. However, the efficient use of space is an ongoing concern, and standard cryovials are often much larger than necessary. Working with UAF's College of Engineering and Mines and the Office of Intellectual Property and Commercialization, we developed and patented a new cryovial half the height of a standard 2-mL cryovial but stackable and interlocking such that two fit in a single cell of a standard 81- or 100-cell box. These cryovials would double the capacity for small-volume samples (e.g., insect legs; biopsy punches; and tissues from small or larval fish, mammals [e.g., shrews], and birds [e.g., hummingbirds]). Prototypes have been 3D printed and preliminary discussions with manufacturers are underway, but provisional buy-in from other institutions will accelerate the time to market. UAM is widely seen as a leader in museum cryopreservation due to our relatively

early adoption of LN2; the sophisticated object-tracking capabilities of Arctos; and the size (>210,000 tissue samples), composition, accessibility, and use of the collection.

<https://osf.io/wh387/>

Casting a Wider Net: The Promise of Digital Transcription for Data Archiving and Dissemination

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GS-01 General Session Oral Presentations

By opening our doors to citizen scientists for data transcription, we are beginning to truly understand the power of the crowd. Engaging the public increases our data output while minimizing the burden on staff and monetary resources. In 2016, the North Carolina Museum of Natural Sciences launched its first crowdsourced transcription project, the in-house, custom built application CitSciScribe. To date, 373 transcribers have completed 12 projects totaling 44,683 transcriptions. Building on this initial success, in 2018 we received a grant from the Institute of Museum and Library Sciences which included creating another crowdsourced transcription project. This project, Castaway, focuses on the transcription of data from research vessel logs and was built using the open-source platform Zooniverse. Here, I evaluated the pros and cons of creating our own transcription platform versus using the Zooniverse platform. I quantified the error rate and time invested in the cleanup of the typed and handwritten data from CitSciScribe and the research vessel data from Castaway. I also compared the time to completion between one of the first projects transcribed on CitSciScribe and the first set of

fields transcribed on Castaway. Data transcription projects provide an effective way to increase our data output while providing our citizen scientists with a new way to access our collections and understand their value. In harnessing this power, we also provide the opportunity for them to become a part of disseminating collections data to the world. *Keywords:* Data transcription, Citizen Science, Crowdsourcing

<https://osf.io/q8kx2/>

Just Smash It! Sampling Techniques of Meteorites for Destructive Analysis

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SY-11 Cosmic Collections: Lets talk about Meteorites

Meteorites contain valuable information of early solar system processes as well as containing data that predate our solar system. The science of Cosmochemistry addresses these questions. The Field Museum houses one of the largest meteorite collections in the world and has a very active scientific loan program. We loan out an average of 75 specimens per year to approximately 20 institutions. However, meteorites are rare and the result is that a balance must be struck to both support science and to preserve our collection for future generations of scientists. As new avenues of scientific inquiry are opened and analytical techniques become more sophisticated, better, more refined sampling techniques are needed with an emphasis on collection preservation.

Because of the diversity of the loan requests based on particular scientific studies and the diversity of the different types of meteorites, each specimen request requires a unique

approach to how it is sampled. Loan requests range from individual minerals found in meteorites weighing several milligrams up to 100 gram bulk samples. We will focus on the loan application and approval process and the various sampling techniques. We will discuss cutting of bulk samples with a minimum of loss and techniques developed to extract individual mineral grains.

Keywords: meteorites, sampling, destructive analysis, loans

<https://osf.io/pt5h8/>

The National Meteorite Collection – From Allende to Zagami -

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SY-11 Cosmic Collections: Lets talk about Meteorites

This talk will serve as an introduction to the National Meteorite Collection housed at the Smithsonian's National Museum of Natural History and an overview of the U.S. Antarctic Meteorite Program, currently the primary source of new meteorites accessioned into the collection. As an active research collection, we provide samples to researchers around the world searching for the answers to Solar System formation.

The National Meteorite Collection is comprised of 19,596 meteorites that came to the museum as gifts from private collections/collectors, unique donations from members of the general public, or were collected by museum staff. A major contributor to the collection is the U.S. Antarctic Meteorite program which returns ~600 meteorites each year, numbering about 16,670 to date.

Meteorites offer special challenges for preservation. Iron-nickel metal common in most meteorites is unstable in an oxygen-, moisture-rich atmosphere. Analyses range from Pb isotopes to organics, all of which are common contaminants. Protection from terrestrial contaminants is similar to preservation concerns of museum collections. Nitrogen cabinets are one way to preserve these pristine samples for years to come, although they also present a challenge in balancing preservation and accessibility.

The Division of Meteorites includes one collections staff member and occasional contractors working with three curators to communicate with researchers and the general public, process transaction paperwork for accessions and loans, pack and ship specimens, monitor storage conditions (including the nitrogen cabinets), record and catalog information pertaining to each meteorite specimen, give 'behind the scenes' tours, respond to requests for collections reports and/or information from the museum's management, and break the bad news that the suspected meteorite you found is actually a "meteorwrong".

Keywords: Meteorites, Antarctica, Collections Storage

<https://osf.io/kpy8u/>

Capturing the Perfect Digital Specimen – An Overview of Vertebrate Imaging Techniques

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GS-02 General Session Poster Presentations

The Vertebrate Zoology Collections team of the Canadian Museum of Nature (CMNVZC) has developed a digitization strategy to increase the

visibility, accessibility and usability of its collection. A key element of this strategy is specimen imaging. The CMNZVC team aims to produce and share 2D and 3D images of vertebrate specimens to support research, collection management, and education. Specimen imaging is a major challenge given the complexity of and extensive variation in forms of the 1,250,000 catalogued vertebrate specimens in the collection, not to mention the various methods of specimen preparation. No single piece of equipment or imaging technique can capture all of the anatomical features of a given specimen. Instead, we use a variety of approaches, including 3D scanning with handheld white light 3D scanners, photogrammetry, computed tomography (CT) scanning, digital photography (with and without focus stacking), x-rays, and scanning electron microscopy (SEM). However, some tools and techniques have limitations depending on the specimen's size, shape, and preservation method. For example, 3D white light surface scanners are extremely useful for producing digital models for morphometric analyses but do not work well on fluid-preserved specimens with reflective surfaces or for imaging small and detailed structures such as fur or feathers. In these cases, photogrammetry can provide superior surface 3D images but the process can be time consuming and often, the photographs need to be optimized. Here, we provide an overview of the advantages and disadvantages of each imaging technique for vertebrate collections.

Keywords: Imaging, vertebrates, 3D scanning, Canadian Museum of Nature, photogrammetry
<https://osf.io/bjesv/>

What We Did with 7,500 Bags of Dried Grass

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GS-02 General Session Poster Presentations

The preparation and curation of genetic resources (“tissues”) from plants requires different processes than those used for animal genetic resources. Animal tissues are generally stored “wet-frozen” in plastic cryovials. Plant tissues, on the other hand, are often stored “dry-frozen” in paper envelopes. To illustrate our methodology, we have chosen grasses (family Poaceae) collected by a Smithsonian curator and his associates. These grass genetic resources were field collected and placed in silica gel for rapid drying. The vouchers for the samples were collected using standard plant press methods, which we will not describe here. Because the Smithsonian’s National Museum of Natural History (NMNH) Biorepository did not yet exist when this collection was made, the samples were kept in the curator’s lab at room temperature due to lack of adequate freezer space. To integrate this collection into the Biorepository, it involved: packing, transport to another building, unpacking, inventory/evaluation, removal of silica, transcription of information to new envelopes, rehousing samples and database work. Rehousing of the collection required a fast and efficient method that allowed the complete removal of any contaminating DNA between samples from our instruments, which we describe here. We did experience some difficulties with the process, such as obscure handwriting, safety concerns, outdated taxonomic names on containers and questions about provenance. Most of these difficulties we eventually resolved in a satisfactory manner. In the long run, we have made the collection better preserved, curated, and more accessible to the scientific community.

Keywords: genetic resources, grasses, rehousing,

curation
<https://osf.io/es9hp/>

Imperfections on Display: Piloting a University Marine Science Exhibit with the Pathological Skeleton of a Bottlenose Dolphin (*Tursiops truncatus*)

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GS-02 General Session Poster Presentations

Biodiversity hotspots are richly packed with flora and fauna, which are often critically threatened by anthropogenic impacts. The rich diversity in the Western Atlantic Ocean, along Florida's East coast, has attracted numerous researchers and students concentrating their academic endeavors in the marine sciences, and eco-tourists from around the world. Our goal is to introduce a marine specimen for display on the Florida Atlantic University (FAU) campus for educational use and to communicate continued academic research within the region. The specimen selected to pilot the marine science display was the skeleton of an adult male bottlenose dolphin (*Tursiops truncatus*) that was necropsied at FAU's Harbor Branch Oceanographic Institute in May 2018. The individual had osteopathological abnormalities, such as signs of ankylosing spondylitis in the form of three fused thoracic vertebrae (Th3-Th5). The skeleton was buried for five weeks in dry, sandy soil before being soaked in 12-17% hydrogen peroxide for whitening. Skeletal elements are being articulated for display in FAU's Physical Science Atrium to highlight the

anthropogenic challenges facing coastal marine mammals and ecosystems. Due to the dolphin's bone pathology, this exhibit will facilitate interdisciplinary interactions among faculty and students on campus and regionally. Finally, this display will be used to engage local K-12 students and the general public during campus visits.

Keywords: dolphin skeleton, osteopathology, university campus display
<https://osf.io/kxmur/>

Taxonomic Classification of *Diplazium molokaiense*, a Fern Endemic to Hawaii, Using Molecular and Morphological Characters

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Diplazium molokaiense is an endangered fern species endemic to Hawaii. There are only an estimated 61 individuals remaining in the wild, all on Maui, one of the Hawaiian Islands. Taxonomic classification of this species is an important element to its conservation. Using the following morphological characters: sori size and shape, scale size and shape, and frond shape, *D. molokaiense* was preliminarily placed into the *Diplazium* genus. Six regions (*rbcL*, *matK*, *atpA*, *atpB*, *trnLF*, and *rps4-trnS*) of the chloroplast genome were amplified and sequenced using Sanger-sequencing. Sequences for outgroup taxa and 20 *Diplazium* species were downloaded from GenBank and used to infer a phylogeny. Our data provide evidence for the phylogenetic placement of *D. molokaiense* and can aid in its conservation.
<https://osf.io/6ren5/>

Diversification and Niche Evolution in Neotropical *Tibouchina* s.s. (Melastomataceae)

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GS-02 General Session Poster Presentations

The Neotropics contain around 37% of global plant diversity; two understudied Neotropical biodiversity hotspots with extremely high levels of endemism are the *Cerrado* (tropical savanna) and the *campos rupestres* (“rocky fields”). Contributing to the plant diversity of these ecoregions are certain lineages of Melastomataceae, including the paraphyletic genus *Tibouchina* Aubl., which occurs in these open habitats across a range of soil types, temperatures and elevations. This study investigates the prevalence of ecological divergence and the impact of niche evolution on the diversification of *Tibouchina* s.s., a Neotropical clade comprising 23 species that are primarily restricted to the *Cerrado* and *campos rupestres*, including both widespread and narrowly endemic species. To investigate the extent of ecological niche shifts within this clade, we constructed ecological niche models in MaxEnt for each species using herbarium records from GBIF, iDigBio, and speciesLink, climate variables from WorldClim and soil variables from SoilGrid. Predicted niche occupancy profiles show ecological divergence for specific environmental variables, and geographic projections show that although there are some areas of projected overlap in

geographic space, a number of species of *Tibouchina* occupy distinct niches. Future studies will use these models and a well-resolved phylogeny for this clade to reconstruct niches for ancestral nodes on the phylogeny to examine the effects of ecological niche shifts on diversification. As a part of a broader research study, this project is a case study on the impact of niche evolution in the diversification of individual plant clades, helping clarify general patterns in Neotropical plant diversification. <https://osf.io/njq85/>

Collection BioBlitz: Enhance and Broaden Undergraduate to Graduate Learning Experiences with University of British Columbia, Beaty Biodiversity Herbarium Specimens

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GS-01 General Session Oral Presentations

The Beaty Biodiversity Museum (BBM) houses over two million biological research specimens, with nearly 70% available on-line, unlocking a wealth of information for research and teaching. Up to our public opening ten years ago, many of our collections were not used in most UBC Biology Program courses due to the lack of staff to coordinate student activities. Our Collection BioBlitz was initiated from a Museum collection goal to inventory and digitize 100% of our collections and a UBC Biology teaching goal to facilitate active learning techniques for undergraduate students. For the past 2 years we invited different undergraduate biology courses to participate in hands on specimen activities. In return, the students inventory our collection looking for specimens missing in the database. Once these specimens are ‘found’, we then

image and upload to Zooniverse or Notes from Nature, facilitating opportunities for all students and public to participate in the collections digitization. The Collection BioBlitz has expanded the undergraduate learning experience to 1,200 students, inventorying more than 10,000 specimens and digitizing collections which would have laid on shelves unknown without this initiative. We find this to be a great reciprocal system consisting of undergraduates broadening their understanding of natural history collection information (e.g. labels and geolocations), while also helping us to find ‘lost’ specimens in the collection.

Keywords: Collection BioBlitz, Undergraduate Opening Learning, Inventory, Digitizing
<https://osf.io/76ys2/>

Partnering with the Beaty Biodiversity Museum to Enhance Learning Experiences for First-Year Students in the University of British Columbia’s Biology Program

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GS-02 General Session Poster Presentations

The Beaty Biodiversity Museum (BBM) is home to UBC’s biological research collections and hosts over two million specimens—a wealth of potential for teaching and research projects. However, most UBC Biology Program courses do not use the Museum as a teaching resource or use only the public displays. This project focuses on first-year students and seeks to integrate research collections into large-enrollment (100+ students) courses. A major barrier is the amount of effort required by Museum staff to coordinate student activities at the BBM. One solution is to use BBM specimens from the UBC Herbarium,

accessible online via the Consortium of the Pacific Northwest Herbaria website. The questions discussed here are: 1) how are first-year students’ knowledge, interests and perceptions of biological diversity impacted by interacting with research collections? 2) does this impact differ if students interact with specimens online compared to in-person? Student responses to written questions in two first-year courses were collected via a survey given prior to and after students completed a 2-hour activity using BBM specimens, either online or at the Museum. Preliminary results suggest that students benefited from interacting with authentic research collections, with both the online and in-person activity showing a similar impact for students.

Keywords: Collection BioBlitz, Undergraduate Opening Learning, Inventory, Digitizing
<https://osf.io/rmwfh/>

Vibration Testing and Mitigation Design for SUE Gallery

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As the Field Museum undertook to move its iconic *Tyrannosaurus rex* specimen named SUE to a new gallery floor, the museum engaged WJE to assess the vibration response of the gallery floor as well as to investigate, design, and assist with the installation of vibration mitigation measures at the new location.

In this poster session, you will learn the approaches considered, the testing methods employed, and the final solution that was developed to dramatically reduce floor vibrations in order to protect SUE.

<https://osf.io/fzqb4/>

Strategies for Associating the Dissociated at the National Collection of Vascular Plants (DAO)

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GS-02 General Session Poster Presentations

Botanical herbarium vouchers are typically affixed to an archival-quality sheet. When a specimen component, such as detached bark or fruit, is too bulky to mount onto a herbarium sheet, it is placed in a box and stored separately in the collection. These components are usually linked to their associated herbarium sheet using duplicate labels. However, these links may be incomplete or misleading, making it difficult to correlate a herbarium sheet with all of its associated parts.

At the National Collection of Vascular Plants (DAO) of Agriculture and Agri-Food Canada, this problem was encountered when digitization staff began to process coniferous specimens that were comprised of a sheet and corresponding cone. The cones were stored in a separate cabinet, uncategorized, and many did not have complete label data that matched the herbarium sheets. There was concern that sheets and associated cones would be barcoded and digitized separately, rather than being treated as parts of a single collection.

Before digitization could proceed, a workflow was developed to match each sheet with its corresponding cone. Using this strategy, we were able to reassociate the majority of our previously dissociated coniferous specimens. Reassociating prior to digitization made the digitization

workflow more efficient and prevented duplicate errors from being introduced to our database. This process also improved the usability of this section of our collection. This simple strategy can be applied to many types of natural history collections that have dissociated material. A visual representation of this workflow will be presented.

Keywords: Dissociation, collection organization, workflow efficiency
<https://osf.io/d8f2b/>

Encouraging Women in Science Programs: An Intern's Perspective

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GS-01 General Session Oral Presentations

Over the summer of 2017, I was a Women in Science Intern in the Fossil Invertebrate Collections at The Field Museum of Natural History (FMNH). I was a part of a team digitizing the Thomas V. Testa Mazon Creek Collection. I sorted through over 1,881 fossil specimens ranging from shrimp (*Acanthotelson simpsoni*) to sea jellies (*Anthracommedusa turnbulli*). Along with working behind the scenes in collections, I shared my work with museum guests from all over the world in the main hall of the Field Museum. I focused my presentations on 300 million-year-old fossilized sea jellies from Illinois. My favorite part about giving these presentations was that I was able to get people excited about fossils and explained the importance of museum collections. In addition to these experiences inside The Field Museum, I also had the chance to visit the Mazon Creek region and meet the fossil collector Thomas V. Testa. After interviewing Testa, I realized that I

wanted to further develop my passions and find my own “Mazon Creek” to devote my life to.

Since completing the Women In Science internship, I had another opportunity last summer to work in the Fossil Invertebrate Collections on the Institute of Museum & Library Services (IMLS) Ordovician Digitization Project. I created 1,126 catalog records in the EMu database and created 2,120 photographs of the fossils and their labels. This internship taught me not only more about museum collections but also showed me that I really do love science.

From my experience as an intern, I have realized that programs, such as the Women In Science internship at The FMNH, are invaluable in closing the evident gap that exists in the sciences. Without having these experiences at FMNH, I am not certain that I would have confirmed my interest in geology.

Keywords: women in science, fossils, digitizing museum collections, internship
<https://osf.io/q8cnz/>

BHL and Specimen Collection Data: The Needle in the Festuca Stack

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GS-02 General Session Poster Presentations

Data contained in the the Biodiversity Heritage Library (BHL) describes collections held in the world's major museums. Finding those collections data, however, remains a challenge. A literal needle in a Festuca stack as some have noted. BHL is actively engaging in incorporating tools (including DOI's and the recently launched

full-text search) to make finding and linking to collection specimen information better. Still, it is not easy to find specific collections information in the non-semantically tagged BHL content. This poster session will call for ideas on how to better surface this content.

BHL is an international consortium making research literature openly available to the world as part of a global biodiversity community. The BHL was created in 2006 as a direct response to the needs of the taxonomic community for access to early literature. The original BHL organizational model, based on United States and United Kingdom partners, provided a template for what is now over 80 global partners. Through this extensive network of Members, Affiliates, and partners, over 56 million pages of biodiversity literature are available through the BHL portal.

BHL changes the lives of researchers and assists the work of collections managers. An African botanist compares a specimen's published description to field notebook details on its collecting history. Harvard's Museum of Comparative Zoology (MCZ) has leveraged BHL directly by adding links to the MCZ database for ledgers, field notes, transcriptions and published literature thus reinforcing connections between specimen data and interrelated historical sources. By enhancing the daily work of Smithsonian and Harvard research, BHL provides a global network of researchers with an easy-to-use digital library of content and services.

Keywords: BHL, Biodiversity Heritage Library, Collections Citations, Collections, literature
<https://osf.io/46aky/>

Standardization and Data Flexibility: Lessons Learned from Digitization of a Large Lepidoptera Natural History Collection

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SY-05 Managing And Digitizing Large Collections

Large new natural history collections are faced with many challenges. The McGuire Center for Lepidoptera and Biodiversity (MGCL) at the Florida Museum of Natural History (FLMNH) contains an estimated 3-10 million samples of butterflies and moths and is continuously acquiring hundreds of thousands of specimens annually from private and institutional donors. The MGCL was founded just over a decade ago from merging the Allyn Museum, Florida State Collection of Arthropods and University of Florida collections. MGCL holdings include pinned Lepidoptera that have been reared as caterpillars or collected as adults, Riker mounts, caterpillars in ethanol vials, wing vouchers, molecular resources, and microscopic slides. MGCL does not have an institutional legacy database and is currently creating one in Specify that will contain images and transcriptions from all holdings. The MGCL digitization workflow includes imaging the dorsal and ventral sides of pinned adult butterfly and moth specimens and their labels. As a rapidly growing collection, one of the major challenges is how to quickly standardize and capture data of collection holdings while simultaneously trying to accession new acquisitions. We present progress on underwing moths (*Catocala*; approximately MGCL 30,000 samples) to illustrate how MGCL organizes image/transcription data, tracks the processing steps of each sample, and files into the collection. We use a simple, taxonomic, hierarchy-based file structure that minimizes nesting folders and provides information to track image quality. We use software to automatically

read barcodes, scripts in ImageMagick to automate image editing and Globus to manage file uploading onto SCAN and iDigBio. We established a system to have one person in charge of catalog numbers and have standardized collection data language to quickly accession samples from institutional donors. We also discuss the challenges in data storage and how to standardize data from different sources (pinned insects, molecular holdings, Riker mounts, and caterpillars) to create a unified database.
Keywords: Lepidoptera, flexibility, standardization, digitization, digital file storage, automation
<https://osf.io/n3utj/>

The Fossil Insect Collaborative Thematic Collection Network

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GS-01 General Session Oral Presentations

Funded in 2013 by the NSF ADBC Program, the Fossil Insect Collaborative Thematic Collection Network (FIC-TCN) aimed to digitize just under 500,000 specimens held in the collections of nine institutions in the United States (seven funded members and two unfunded federal partners); two additional institutions were later funded as PENs. TCN members interacted via in-person and online meetings to discuss equipment setup, workflow development, imaging protocols, iDigPaleo development, etc.; site visits were invaluable later in the project. As of 2019, digitization is mostly complete, with specimen records, including thousands of images, available via the iDigBio, GBIF, and iDigPaleo portals. Over the course of the project, the digitization and data publishing landscape changed in unanticipated ways. iDigPaleo, originally conceived as the primary data aggregator for the

TCN, shifted to focus more on its education and outreach capabilities. These include browsing image rich collections records using clickable filters instead of typing terms into a blank search box and hosting K-12 classroom activities that utilize the portal's annotation and measurement tools. Participation in the FIC-TCN resulted in many positive, but unexpected, outcomes. As a group, we were better able to connect to the neontologic community by giving presentations at meetings and workshops and some TCN members began sharing data and images with entomology specific portals. Several members were able to leverage the TCN to increase institutional support for improving the storage conditions of their fossil insect collections. One institution identified a collection of specimens, including types, that belonged to another museum and repatriate them while others accepted new specimen donations, greatly increasing their fossil insect holdings, all due to connections made by the TCN. Overall, the project has been much more than digitization and has improved our collections in many unanticipated ways.

Keywords: digitization, paleontology, fossil insects
<https://osf.io/pm7gh/>

Larger Specimens: Addressing the Need for Wide-Mouth Jars in Collections

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GS-01 General Session Oral Presentations

An ongoing problem in fluid collection management is finding high quality, reasonably

priced glassware to accommodate a diverse range of specimen sizes. With shifts in the manufacturing industry, several sizes of jar stock have become largely unavailable. As a result, curation needs of larger specimens (not oversize) are being met with less than desirable options: plastic buckets, placement into crowded tanks, or altered to fit in available glassware. These options contribute to alcohol outgassing and can cause harm to the specimen.

The National Museum of Natural History, Department of Invertebrate Zoology reached out to several manufacturers to find a wide-mouth jar for larger, non-oversize specimens and finally found a 3500 ml and 5000 ml soda-lime jar. Through contacts in the manufacturing industry, we will be able to make a flexible polypropylene lid with a teflon liner. These jars will provide an opportunity to move certain invertebrate zoology collections from plastic buckets and allow for the decompression of the vertebrate zoology tank collection. Although stable in collections for a hundred years, soda-lime glassware has received some negative attention. A properly annealed soda-lime jar following the highest production standards is very resistant to etching, durable, affordable in today's collection management budgets, and is equally resistant to breakage as borosilicate glass. If not manufactured properly, soda-lime jars are less resistant to chemical etching and thermal shock. The lessons learned in purchasing a high-quality soda-lime jar are discussed.

Keywords: Wet Collections, Supplies, Specimen Storage

<https://osf.io/2nmu3/>

Wasps and Bees on Display – A Case Study on Live-digitization in the Exhibition

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GS-01 General Session Oral Presentations

The Museum für Naturkunde Berlin (MfN) is granted additional funding to enhance and disclose its collections. The project presented here will serve as a test case for the future plan. The aim of this project is the complete reorganization, digitization and disclosure of the Hymenoptera collection (wasps, bees and ants) in the public space of the exhibition as a model project for the complete development of the collections of the MfN. On the one hand, digitization processes are being tested and optimized. On the other hand, visitors of the MfN will be involved in a variety of knowledge transfer and participation formats regarding the collections and digitization activities of the MfN and the importance of Hymenoptera in the context of current scientific and societal debates.

The new set-up in the exhibition is a combination of historical and new cabinets to compare the old collection in old drawers and cabinets and the newly reorganized collection to directly see the improvement. Furthermore, the set-up of a variety of digitization stations in the exhibition hall will further allow making visible the complex process of collection digitization.

The Hymenoptera collection is particularly suitable for live digitization and as a test case for process testing for many reasons. The collection is with approximately 2.3 million specimens one of the biggest collection units of the MfN and at the same facing immense backlog in terms of conservation condition and digital access as a collections assessment reveals. The Hymenoptera collection thus provides the

opportunity to create, record and digitize an object-rich collection from scratch.

The project offers the opportunity to make the realization of the future plan visible and tangible by means of a very concrete example, including the public. In addition, Hymenoptera are particularly suited to be used in the context of a live digitization, currently in the public intensively perceived topics. In the discussion about the current loss of biodiversity, especially the bees play a prominent role. Bees are popular and almost iconic for the current debate about the insect decline. Social and other wasps are in the discussion as culture followers and molesters so that live digitization offers the opportunity to show their role in the ecosystem and for humans.

Keywords: live science, collection enhancement, digitization, outreach, exhibition

<https://osf.io/cea8u/>

Why ‘Mite’ Feather Mites Be Important? And How Can Collections Help Guide Research?

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GS-02 General Session Poster Presentations

Feather mites (Acariformes: Astigmata: Analgoidea and Pterolichoidea) are among the most diverse avian ectosymbionts with >2,000 described species but 80% remaining undescribed. In addition to the many awaiting systematic and taxonomic discoveries, we know very little about the ecology and evolution of a few described species. The Boves Lab at Arkansas State University, along with collaborators across the globe, is working to identify and describe new mite species, clarify the nature of the ecological interaction

(parasitism, commensalism, or mutualism), and to explain co-evolutionary trends between mites and their hosts. An important component of this research has involved collection of feather mites for identification and genetic analyses. We recently described four new species of feather mites in the genus *Amerodectes* and have collected hundreds of mites for future curation and identification. These mites provide opportunities for curation experience, ecological and evolutionary research, and outreach. By considering New World Warblers (Parulidae) as mite host species, we ultimately hope to describe more new species of mites, inform decisions regarding avian conservation as it relates to feather mite interactions, and characterize the evolutionary mechanisms that shape this symbiotic system.

Keywords: feather mites, symbiosis, New World warblers

<https://osf.io/2qadc/>

American Purple Gallinule: An Unlikely Representative of Northwoods Biodiversity

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SS-01 Specimen Spotlight

The Cable Natural History Museum's (CNHM) collection consists of just over 4,000 plant, animal, and geological specimens representative of Northern Wisconsin. This geographic area covers the Northern Highlands and Lake Superior Lowland regions. While objects which do not naturally occur in this described area may be considered for accession for comparative reasons, the CNHM holds only a few such specimens. In 2018 a member of the public offered the salvaged remains of an immature American Purple Gallinule (*Porphyrio*

martinicus) for deposit at the CNHM.

Information provided by the collector both warranted its acquisition and indicated that the specimen would make a unique addition to the CNHM's permanent collection.

This particular bird had been collected from a frozen bank of the St. Louis River near Duluth, Minnesota--an area adjacent to the described Northern Wisconsin region. Intriguingly, the species primarily inhabits freshwater wetlands throughout areas of the Caribbean and parts of Central America but has a documented history of occasional vagrancy to various locations well outside historic distribution. A few months after I had accepted the salvaged remains, our Collections Monitor prepared a taxidermy mount of the bird. Written notes and photographs were compiled throughout the preparation process, as thorough documentation will support its scientific value. We further took special care to uphold its anatomical structure and beauty as we prepared the bird for public display. This new specimen is now a valuable part of the collection at the CNHM. Visitors may compare it with similar specimens when viewing it in our display room or through our virtual collections database. As we continue to preserve the specimen and its accompanying documentation into the future, we anticipate it will also provide valuable insight regarding the unique natural history of the American Purple Gallinule.

Keywords: American Purple Gallinule, Salvage, Vagrancy

<https://osf.io/pfmvq/>

Balancing Efficiency and Accuracy in the NHMLA Invertebrate Paleontology Collection

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SY-05 Managing And Digitizing Large Collections

The invertebrate paleontology collections of the Natural History Museum of Los Angeles County (LACMIP) are the fifth largest in the country, with an estimated 4-6 million specimens. Three digitization projects funded by the National Science Foundation over the past five years have enabled the digitization and/or mobilization of occurrence records for ~2 million of these specimens. Based on this experience, we report on quantitative digitization metrics, including actual time per specimen/lot per task. We also discuss factors of digitization efficiency. Unfortunately, increases in efficiency often come at a cost to the quality of specimen physical preservation, digital data, or both. The overarching goal of digitization projects at LACMIP is to improve physical curation while producing research-ready digital specimen data, and given the size of the collections, efficiency is critical to accomplishing this goal. We review strategic workflow designs (e.g. the use of validated taxonomic dictionaries, pre-digitization curation, etc.) that have enabled LACMIP to maintain pace on digitization projects without sacrificing physical or digital specimen quality. Finally, we conclude with an overview of our stratigraphic inventory project, and the role we see for it in a near future where digitization in the largest collections is sustained by on-demand data mobilization.

Keywords: paleontology, digitization, inventory
<https://osf.io/4zbfk/>

If a Small Collection Exists in the Forest, Does Anybody Know It's There? Research Value and Digitization Progress of Field Station Collections

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SY-13 SCNet Symposium: No Collection Left Behind: Research Contributions of Small Collections

Worldwide, over 900 Field Stations & Marine Labs (FSMLs) provide critical physical infrastructure for immersive research in just about every possible type of environment. The place-based nature of FSMLs makes them natural repositories for continuous site-specific data, including biological specimens. In fact, biological collections are among the infrastructure that makes an individual station appealing to researchers and other visitors. We discuss common characteristics of biological collections held by FSMLs, as well as the unique research value of such collections, and the digitization progress made within this community. FSML collections are typically small in size and regional in scope. Because FSMLs function as interdisciplinary, multi-audience hubs, their collections serve diverse user groups and may experience simultaneously more access and less consistent curation than we expect of similarly-sized collections housed at museums and universities. We qualify these issues in the context of the research opportunity that digitization brings to FSML-based biological collections.

Keywords: field station, digitization, research infrastructure
<https://osf.io/6vtmq/>

Beyond the Visible Spectrum: The Use and Application of Ultraviolet (UV) Light Photography as a Diagnostic Tool for Discovery, Digital Documentation and Analysis of Paleontological Specimens

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GS-01 General Session Oral Presentations

The use of UV photography is a valuable diagnostic tool for improved visualization of rarely seen data such as soft tissue preservation and fine structures in the invisible light spectrum of paleontological specimens. This enhanced visual data is of particular importance to the study and documentation of the bulk of our collection of Solnhofen limestone fossil specimens. We sought to develop a standardized, time efficient and easy to use system to obtain consistent, high quality images. We tested and developed a system using standard digital cameras; relatively affordable UV lights; polarized and colored filters; consistent camera settings and workflow; a visible but non-invasive tile to indicate data not captured in camera metadata; and designed a flexible camera workstation consisting of a camera stand; UV light array with adjustable stand; 4k monitor; heavy duty table with hydraulic lift to accommodate widely diverse sizes of specimens to obtain a sequence of digital images ranging from visible light through the ultraviolet spectrum. These images provide greater understanding of morphology, mineralization, geologic data and manmade interventions of paleontological specimens.

Our UV photographic protocol captures far greater data than the human eye to quickly and easily identify soft tissue preservation such as skin, scales, dermal denticles, feathers, pycnofibers, provides clarity, definition and fine detail of morphology, stomach contents, trace fossils, and clearly identifies negative and positive fossil material. All of these newly visible data provide greater understanding of

species and their environment for the advancement of science.

UV photographic imaging of older, previously prepared specimens, reveal a history of techniques and methods used, both good and bad, and identify manmade interventions where breaks, repairs, areas of restoration, and use of glues, epoxies, fillers and paints or surface treatments were applied. These data are virtually invisible in the visual light spectrum, discovery and documentation is of critical importance to the integrity of scientific data analysis of fossil specimens.

The data obtained through the use of UV photography influenced improvements in our fossil preparation methods to include prepping all material under a microscope, periodic use of UV light throughout the fossil preparation process to preserve soft tissues and limiting the use of surface treatments.

The use of UV photography as a diagnostic tool for discovery, documentation and analysis of fossil specimens can be easily incorporated into regular use of all institutions.

Keywords: UV, UV Photography, Diagnostic Tools
<https://osf.io/sezct/>

Unlocking the Potential in Backlogs: A Case Study of Holistic Sampling on Frozen Backlog Specimens

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GS-01 General Session Oral Presentations

Holistic sampling of natural history specimens has greatly expanded the role of the museum in contributing to modern research, with genetic and pathogen research now possible using current preparation techniques (Schindel and Cook 2018). An example of this is the Highton Salamander Collection at the National Museum of Natural History's Division of Amphibians and Reptiles, which encompasses over 30 years of sustained collecting at multiple sites across the eastern and southern United States. Backlog specimens in this collection, stored in -80°C freezers for over 40 years, presented a unique opportunity to use modern sampling techniques on unprocessed historic specimens. In 2017, a team of technicians from the Museum's Collections Program developed a fast-paced method of preparing over 2,500 of these salamanders as research quality fluid specimens. In addition to preserving collecting data that was stored in the original frozen bags, the technicians collected DNA tissue samples and epithelial swabs to test for the presence of pathogens. These historical samples are currently being used in studies of salamander genetic diversity and the prevalence of fungal pathogens in vulnerable populations of amphibians across time and space. The results of this project demonstrate the unanticipated value of unprocessed backlog collections and the role of natural history museums in solving modern scientific questions.

Keywords: holistic sampling procedures, Highton Collection, herpetology specimens, backlog processing, chytrid fungus
<https://osf.io/ghyw4/>

Rescuing Endangered Collections

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GS-01 General Session Oral Presentations

College students can play a crucial role in keeping university collections from being lost through abandonment or neglect. I will discuss my experience with "rescuing" collections at two separate colleges: College of the Atlantic in Bar Harbor, Maine, and Sweet Briar College in Virginia. At College of the Atlantic in Bar Harbor, Maine, I worked at the Dorr Museum and co-managed the natural history collections on campus. I focused on integrated pest management and started an independent project of systematically cleaning and restoring what I could of a dermestid and mold-ridden entomological collection. I personally oversaw a portion of the David Rockefeller insect collection and while we can collect most of these insects today, the historical significance is far greater than the object itself. Having recently transferred to Sweet Briar, I have formed an amazing partnership with the Randolph College Natural History & Archaeology Collections Project, where I am expanding my knowledge about the role of natural history collections while working with Sweet Briar faculty in an effort to locate, catalogue and preserve the portions of the collection which were put in storage and forgotten when Sweet Briar faced closure in 2015.

Keywords: entomology, history, college collections, Sweet Briar, students
<https://osf.io/c2w8g/>

Living Atlases: Using ALA as Thematic or National Data Portal

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SY-03 Interconnectedness Of Data

Since 2010, Atlas of Living Australia (ALA) has provided information on all the known species in

Australia and contributed to the Global Biodiversity Information Facility (GBIF). It has become a national open source platform, and its open and modular architecture enables re-use of its tools by other countries and regions.

In the past six years, through several international developer workshops and with the support of GBIF, ALA has built an open source community around its software called Living Atlases. Thanks to the community work, the ALA platform as a national data portal is the solution recommended in the GBIF Implementation Plan 2017 - 2021, and we have started to build an official foundation similar in form to Linux or the Apache Foundation.

National or thematic portals can provide a tailored view for a country or a region, allowing an institution to bring together region-specific information (attribution, species lists and traits, spatial layers) to further enhance the basic occurrence information. They also provide an important mechanism to galvanize data mobilization efforts within a country or a region.

During this presentation, we will focus mainly on the data portal in order to show how it works, from data indexing to the collection module and the search of occurrences or species. We will also explain how you can install and configure your own data portal based on ALA.

Keywords: ala, living atlases, gbif, data
<https://osf.io/ew87p/>

Preserving the Dry Coral Collection at the American Museum of Natural History

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GS-02 General Session Poster Presentations

As global temperatures rise, many marine species struggle to survive in oceans with increasingly high levels of atmospheric carbon dioxide. Due to the consequent decrease in environmental pH which interferes with their ability to form calcium carbonate skeletons, living corals are among the species which find themselves threatened worldwide. The percentage of coral reefs that have been lost or severely damaged across the globe as a result of human activity is a figure that defies precise calculation; it is estimated, however, that between 19-60% of reef-building corals are at risk of extinction, and it is indisputable that the amount of living coral available for study is disappearing at an unprecedented rate.

The American Museum of Natural History (AMNH) maintains a small but notable coral collection of approximately 3,000 specimens, including exceedingly rare species as well as specimens collected prior to the establishment of the AMNH in 1869. Despite its historical significance and research potential, this collection has remained largely inaccessible to the scientific community due to outdated storage conditions and a lack of digitized data. To satisfy the growing demand for physical and virtual access to this collection and to ensure its longevity, in 2016, the AMNH was awarded support from the Institute of Museum and Library Services (IMLS) to rehouse, conserve, and digitize its dry coral collection.

This poster illustrates the process and challenges of cleaning and rehousing the collection in conservation-grade storage facilities, updating its taxonomy, and cataloging each specimen in the museum's KE EMu database. By 2020, the AMNH will be able to share with the world this remarkable collection and a wealth of data which may be used to study coral growth over time, combat reef degradation, and ultimately preserve

the future of our living coral.

Keywords: AMNH, Collection, Conservation, Coral, Digitization, IMLS, Rehousing
<https://osf.io/dn35h/>

Dark Matter Matters

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GS-01 General Session Oral Presentations

Biological collections hold hundreds of millions of specimens globally, and information from these specimens is increasingly being made available electronically to researchers, government agencies and the wider community. In herbaria, label information and specimen images comprise the majority of available digital data, but what other objects and information exists in these collections that are currently ‘dark’, and need to be exposed, and if so, how best to do this? We examined these questions using the *Diuris* (Orchidaceae) collections at the Australian National Herbarium (ANH). Orchid collections at the ANH are particularly complex, reflecting an active research program across disciplines over many years. The collections comprise not only dried herbarium sheets and associated images, but also floral cards, living plants, SEM images, specimen field books and line drawings. Our project aims to develop a prioritised system of capturing and imaging these objects and data, and to investigate the capacity of data management systems to deal with this additional information. Results from this study will then be applied to the remainder of the ANH collections, thereby allowing other ‘dark matter’ to be exposed, disseminated and utilised.

Keywords: Herbarium collections, digitisation, images, floral cards, living plants, SEM images, specimen field books, line drawings, Orchidaceae
<https://osf.io/hmfyz/>

Digital and Physical Curation of Illegally-Collected Vertebrate Fossils with Sparse, But Critical, Locality Data

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GS-01 General Session Oral Presentations

Western North America has an incredible fossil record of interest to professionals and amateurs alike. As such, a continuing problem is the illegal collection of vertebrate fossils without a permit from public lands. Here I describe the collection, abandonment, rediscovery, workflow, curation, and investigation required for 77 boxes of over 2,000 mostly vertebrate fossils that were illegally collected from the lower Eocene Bridger Formation of southwest Wyoming from 1986 to 1988. Most if not all of the specimens came from Bureau of Land Management (BLM) lands, and were the subject of a law enforcement case prior to being repositied by the BLM at the Natural History Museum of Utah (UMNH). The individual who collected these fossils had a working knowledge of anatomy, a rough idea taxonomy, and the importance of writing down locality data

From a phone call from law enforcement, to an abandoned storage locker, to our climate-controlled collection, there was much to these fossils’ journey. When fossils have been collected illegally, there is added pressure to curate them using best practices. After the fossils were emptied out of the mouse dropping-infested

storage locker, they were immediately frozen in our -30 degrees walk in freezer. After two weeks of being frozen, they were transported to our climate-controlled collections room. Next, they were unpacked, ensuring the digital documentation of the locality and taxonomic notes. Locality data was largely written on the outside of boxes; therefore, we recorded all available information and plotted these data using Google Earth. When an estimation of the locality was acquired, a new site record was created for it. Some of the locality data provided spatial information about the distribution of the paleontological localities, which is valuable contextual information. Then the fossils were assessed for scientific importance, need for fossil preparation/repair/conservation, and their taxonomic identification was reassessed. Once prepared, the fossils were housed in Ethafoam-lined acid free archival boxes. Digital records for each specimen and site were created in our collections management database system EMu. These workflows and practices allowed us to preserve the limited but crucial information associated with the specimens.

Keywords: digital curation, illegally collected, locality data

<https://osf.io/q6ptv/>

Examining Critical Thinking Skills of Middle-School Age Learners with 3D Models of Museum Objects in an Inquiry-Based Learning System

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GS-02 General Session Poster Presentations

The Natural History Museum of Utah has developed an object-based learning system called Research Quests to support critical thinking - observing, interpreting, evaluating, elaboration, problem finding, comparing, and flexible thinking. Research Quest

(www.researchquest.org) provides digitally-supported, inquiry-based learning modules (a series of individual but related investigations) designed to support critical thinking and evidence-based argumentation using 3D models of authentic museum objects, data, interactives, and scientist-led videos that provide essential modeling of critical thinking. Through these technologies, an ever growing collection of digitized museum objects, and careful scaffolding of critical thinking skills, our goals were to answer two questions: “Can digital inquiry with museum objects scaffold critical thinking processes in young learners?” And, “How much do students deploy critical thinking processes during authentic, inquiry-based science learning?” To test these questions, we developed pilot investigations rooted in the mysteries of Cleveland-Lloyd Dinosaur Quarry. In one of these investigations, led by videos of a museum paleontologist, students make observations of 3D digital models of real fossils, “mystery” bones, from our collections and compare those models to 3D models from other known species in the museum’s collections. Students seek to answer two questions: “What type of bone is this?” and “What animal did these bones come from?” This investigation, along with the other two in this module, use a variety of web-based technologies to engage students in their research – 3D

viewers, interactive maps, simulation-based software, and scientist-led videos. Teachers and students are additionally supported through carefully developed instructional guides and student notebooks. Study of the use of Research Quest has shown students who worked with the Research Quest investigations, compared with their control group peers, were significantly more likely to select complex forms of critical thinking as important to scientific investigations, to be able to define strong, weak, and disconfirming forms of evidence, and to effectively evaluate conclusions based upon existing data.

Keywords: critical thinking, 3D models, digital models

<https://osf.io/jtd4n/>

Long Oversized Automatic Shelving

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SY-10 Storage Techniques For Art, Science, And History Collections (STASH) Preventive Conservation And Storage: STASH Flash II

Dinosaur bones tend to be large. Oversized shelving is required to best house these large, heavy fossils. At the Natural History Museum of Utah, we have long, oversized automatic shelving for our large, heavy specimens that are housed on pallets. Here I would like to quickly present on the pros and cons of this state of the art system.

Keywords: oversize, automatic, shelving

<https://osf.io/tw3vd/>

Specimen Digitization at the Canadian National Collection of Insects, Arachnids and Nematodes (CNC)

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GS-02 General Session Poster Presentations

The CNC is the largest repository of biodiversity in Canada with ~17 million specimens, and is an invaluable source of natural history data for invertebrates globally, particularly in Canada and especially Canada's north. Increased access to specimens and digitized data (including images) are integral to fulfilling the mandate of AAFC, which includes facilitating trade, protecting Canadian bioresources, and acting as responsible stewards of the environment. AAFC's Science & Technology Branch is the dominant beneficiary of collection assets, being responsible for key diagnostic activities and primary research into Canadian and global organisms of mostly agricultural concern. Digitized data will rapidly transfer knowledge to stakeholders; aid in diagnostic activities preventing biological threats affecting trade and Canadian bioresources; develop new biosystematics knowledge and tools; develop and test hypotheses on species concepts and phylogenies; elucidate species distributions and changes to populations through time; monitor and evaluate actual and potential invasive alien species; contribute to climate change and biodiversity research; and develop predictive classifications that anticipates biological aspects for species of agricultural concern. Infrastructure development and refined workflows for data harvesting have contributed to increased productivity, and more efficient and accurate digitization. This includes label imaging; the verification, cleaning and geocoding of specimen records; and investment in increased storage capacity and digitization staff (technicians and students). By 2022, millions of specimen records including metadata

and images will be aggregated and developed in the CNC Database, which is globally accessible via an online portal. Data will be accompanied by a full taxonomic inventory (>100,000 taxa estimated), and databasing and high-resolution photography of most of the nearly 17,000 name-bearing types held (60-80,000 images anticipated).

Keywords: digitization, imaging, inventory
<https://osf.io/uy9sv/>

Dashboard Confessionals: Obstacles and Challenges to Measuring the Success of a National Scale Digitization Program

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SY-06 Collecting Measures Of Success

The Advancing Digitization of Biodiversity Collections (ADBC) program is to produce millions of digitized occurrence records from natural history collections in the United States by 2021. Architecture decisions, data models, and sun-setting projects have provided challenges that require novel solutions to deliver a programmatic evaluation of the progress of participating contributors and ultimately connect individual specimens to their institutional collections.

Keywords: digitization, metrics, dashboard, collections catalog, ADBC, iDigBio
<https://osf.io/qkzws/>

Research, Curatorial and Outreach Opportunities at the Mammals' Collection, Instituto Alexander von Humboldt, Colombia (IAvH-M)

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GS-01 General Session Oral Presentations

Museums and biological collections are important laboratories to uncover the secrets of biodiversity and spread the knowledge to everyone. The mammal collection at “Instituto de Investigación de Recursos Biológicos Alexander von Humboldt” (IAvH) mammals’ is the third largest in Colombia, with around 10,000 specimens. In this part of the Neotropics, where two continents collide and a collage of biogeographic regions meet, Colombia stands out by its mammal diversity and the shallow depth we have on its mammal fauna, thereby strong, active collection-based mammal research is essential. Here, I present the history and an overview of the status, content, and the ongoing field and research work at Instituto Humboldt, Colombia, that starting to raise the standard of curation, conservation and accessibility for the research community and the general public.

The IAvH mammal collection was established in 1968, and house specimens collected across Colombia (over 2000 localities in the 32 departments of its territory), with a few specimens from seven other countries: Brazil, Canada, Mexico, Peru, Ecuador, Venezuela and the United States. This collection has a wide taxonomic representation of mammals from different neotropical biogeographic regions, and many ecosystems, that occur in Colombia, such as the Chocó rainforest and Amazonian rainforest, the Orinoco basin savannahs, the tropical dry seasonal and moist forests, to the montane cloud forests, and the Andean savannah-like paramo ecosystems.

In particular, in the IAvH mammal collection, 368 species (69%) are represented, out of a potential of 528 known to occur Colombia. A

total 16 orders and 47 families are represented in the collection, but it is most complete on primates, having material of majority of the species and subspecies reported in the country. Likewise, the collection is rapidly growing with the intense agenda of collecting expeditions and has started to assemble rapidly a frozen tissue collection.

The collection has been recently remodeled, improving its physical spaces, infrastructure and specialized equipment. All these improvements guarantee a better service for the research community, and updated the preservation conditions of the specimens. Currently, we are reorganizing the physical collection, conducting curatorial and conservation activities, and verifying and digitizing of label and catalog data. We are starting to work hard on promoting more researchers to visit and to use the IAvH-M collection. We are open for business. There was no mammal or curator in charge for over a decade, but that has changed. To increase visibility of the IAvH-M, the information of many specimens was released in digital portals through the Colombian Biodiversity Information System (SIB Colombia) which is a node of the Global Biodiversity Information Facility (GBIF). This information will be update soon.

Furthermore, we are working on an online photographic catalog of the preserved specimens in the collection, and on outreach and scientific divulgation activities that are better integrating our collection with the community as a whole.

Finally, this work is an invitation to visit our collection and to include IAvH-M specimens in the research agendas of mammalogists worldwide. In the last few years, the active agenda of field expeditions across Colombia allowed us to survey interesting, unexplored areas where little research was possible in the past due to the violence of the armed conflict that afflicted Colombia.

Keywords: Neotropical mammals, small collection, armed conflict in Colombia
<https://osf.io/apqmc/>

The Mission for the Next Generation: New Permanent Exhibitions for Natural History Collections in National Museum, Prague, Czech Republic

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GS-01 General Session Oral Presentations

The museum exhibition is still one of the most effective traditional tools for providing physical transfer of the collections information/knowledge and access to general public/museum visitors. The National museum in Prague is facing in these days one of the most challenges in its 200 years history, rebuilding a new permanent exhibitions for natural history collections in newly renovated historical building. This challenge is also our commitment to be able to address future generations. The most complicated part is to present the collections in the way to be attractive for future audience as well as still keep the respect to our museum's ancestors.

Our monumental renaissance building was built in 1891 as a dominant on the top of the biggest square in Prague, St. Wenceslas. During the reconstruction the historical building was connected with the underground tunnel to our new building and we created the marvellous museum complex in Czech Republic with more than 12 000m². We are going to open half of the building with natural history part at the end of 2019 with one floor full of animals like invertebrates, fishes, reptiles, birds and mammals. The second floor will be focused on palaeontology evolution during the last more

than 500 million years in area of the modern Czech Republic and historical mineralogical system.

The project has been prepared since 2009 but went through a different eras of the approaches. A few years ago we had to ask ourselves a few simple questions: How to do the permanent exhibitions in these days when you are expecting that will last for decades? Is the way to exclude modern technology the right thing to do? Or should we focus on educative style or more on popularization? And what about cases? Should we use old repaired or modern?

It would be great to know answers to all these questions but we still have to counts with possibilities and limits of our curators, collections, budget, legislation, technology and construction of the building.

The project has no similar equivalent in the Czech Republic in its history so it was an extraordinary challenge to create our own process of realization with ongoing improvements. One of it is cooperation with the Czech University of Technology to develop system for tracking people in exhibition to study their behaviour and habits. We are developing a new modern way how to prepare an exhibition in a system where the role of copywriters and creative consultants in museums is at the beginning.

Keywords: exhibitions, natura history collections, Prague, Czech Republic
<https://osf.io/jr2ah/>

Other Funders to Consider: Funding Funding Other than Federal!

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GS-01 General Session Oral Presentations

New to finding funding? Want to diversify?

Dive in and explore methods of finding funding for museums and museum libraries from private foundations, public charities and corporate giving. The presentation will include a discussion of prospect research methods, demonstrations, and tips and tricks for Foundation Directory Online and the Funding for Libraries Tool, along with other Foundation Center resources such as IssueLab and Grantspace. Research can continue once you get home, through the Funding Information Network these databases are freely available at over 400 locations in the US and abroad.

Keywords: Grants, Private Foundations, Public Charities, Corporate Giving, Libraries, Prospect Research

<https://osf.io/8nhuk/>

A New Plant Genus from a Cabinet of Curiosities

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SS-01 Specimen Spotlight

New Plant Genus Endemic to Iron Ore Outcrops in the Brazilian Amazon: *Brasilianthus carajensis* Almeda & Michelang. is a new monotypic genus in Melastomataceae. This species is known only from iron ore outcrops called 'canga' which consist of open grassy areas or 'campo rupestre' nestled within the Brazilian Amazon Rainforest. Along with other unique plants and animals, the discovery of this new genus from herbarium collections at multiple institutions has helped inform conservation efforts in an area of intense mining interest within the Serra dos Carajás range.

Keywords: herbarium, habitat conservation, iron ore

savannas, canga, taxonomy, Amazon

How to See the Story: Visualizing Specimen Data to Read the Scope and Status of a Collection of Mesa Verde Vertebrates

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GS-02 General Session Poster Presentations

As natural scientists continue striving to understand the rapid changes occurring across Earth's landscapes, the accessibility and utilization of natural history collections are becoming more and more essential. Unfortunately, the inherent volume and multidimensionality of these datasets can prove challenging to summarize, assess and communicate effectively. This can be a significant roadblock to a collection's ability to be a global scientific resource. Innovative data visualization may be one way to effectively examine and communicate the status of existing collections. The developing partnership between Mesa Verde National Park and the University of Colorado Boulder Museum of Natural History (CUMNH) is a fitting case study to explore the possibilities of collections data visualization to inform future research and assess data accessibility. This project investigated the 336 vertebrate specimens collected within Mesa Verde between 1935 and 2018 currently held at CUMNH to assess i) their scope by visually representing the collection's story across time, space and taxonomic diversity, and ii) their accessibility by visualizing metrics such as percentages digitized and georeferenced, variety of preparation methods, and loan activity. Creative data visualization is a potentially powerful tool for allowing specimens to boldly

tell their story to collections managers, researchers and even a broader public audience.

Keywords: Collections management, data visualization, vertebrate zoology, collection history
<https://osf.io/3jdgq/>

Tweaking the System: Using e-Journal Technology and Existing Citation Tools to Increase the Visibility and Measurable Impact of Museums, Curation and Specimen-Based Data

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SY-06 Collecting Measures Of Success

Natural History Collections provide critical resources for many branches of the biological sciences. While the fields of taxonomy and systematics are heavy users of museum specimens and the data they possess, the role of museums and specimens for phylogenetics, conservation, biogeography, community ecology and basic natural history cannot be understated. Despite this, these important scientific contributions, made by museums, curatorial staff and the digitized specimen data, are largely invisible to the most common form of academic attribution: bibliographic citation.

This talk will discuss an effort by the Oregon State Arthropod Collection to convert its traditional 'catalog' into an e-journal format and by doing so, generate citable museum-related products. In this way, the museum maintains the traditional role of its catalog, i.e., to establish an historical record and archive of museum activities, especially associated with the

specimens, but it also provides a means by which those same activities can be cited by the researchers making use of the collection. Furthermore, by consolidating these events into a single journal, museum administration can make use of existing citation indexing to more easily measure the scholarly impact of the museum in the literature it contributes to.

Providing citable museum products (e.g., specimen loans, accession records, digitized specimen datasets, etc), not only benefits the museum, but improves the resulting science by providing a time-stable mechanism so that readers of these scholarly works can access, evaluate and further test the primary data and/or underlying concepts involved in generating the research itself.

Keywords: Citation Metrics, Impact Factor
<https://osf.io/rgpbz/>

Small Herbaria Significantly Contribute Unique Biogeographic Records to County-, Locality-, and Temporal-Level Scales

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SY-13 SCNet Symposium: No Collection Left Behind: Research Contributions of Small Collections

The urgency to have detailed knowledge of plant species' distributions has never been greater, given the negative impacts humans are currently having on global biodiversity. Therefore, it is imperative to develop strategies about which datasets should be included when consulting natural history collections to understand these distributions. While redundancy in collections has value, priority should be placed on unique

records in order to gain a better understanding of species' distributions over time. We asked at which levels small herbaria (i.e., those with fewer than 100,000 specimens) contribute uniquely: county-, locality-, or temporal-level scales. In our subset of 8 US states, small herbaria contributed approximately 30% of the records in our dataset. We found that small collections do not contain redundant specimens with large herbaria. In fact, in our sampling of 40 species per state, we found that small herbaria contributed no less than 20% of the unique records at county-, locality-, and temporal-level scales, and in some cases (S2 rare, e.g.) contributed to the county-level distribution significantly more than expected by the number of records contributed. This quantitative set of results is profound because we show that small herbaria generally contribute unique information in proportion with their number of accessioned specimens. Factors driving the patterns of variation in the data will also be discussed. It has long been recognized that small herbaria have important roles in training and education, but our research now quantitatively shows the unique contributions that small collections make to our understanding of biodiversity patterns. These collections cannot be excluded from data aggregation projects if we want a complete understanding of species distribution in space and time.

Keywords: small herbaria, unique contributions, digitization
<https://osf.io/y3w52/>

A New Natural History Collections Curriculum in Biological Sciences Education

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SY-15 Broadening Participation of Students in
Biodiversity Collections through a Network of Student
Clubs

Natural history collections are foundational to our knowledge of the biological world. Moreover, recent technological advances have resulted in the development of new uses for natural history collections, beyond what historical collectors and specimen curators envisioned. Rapid environmental change and habitat degradation necessitate the preservation, expansion, and data sharing capabilities of natural history collections. Educating experts to properly curate and utilize collections in research is a critical need in science education.

Additionally, broadly training future scientists and physicians to appreciate the wealth of basic biological and natural history knowledge learned from exploration and natural history collections is needed in a general biology degree program. As part of an NSF-funded training scholarship program, we have developed a two-course series: (1) Curation of Collections and (2) Natural History Collections Research Design. Curation of Collections emphasizes current, appropriate museum-quality specimen curation and data management so that students receive an introduction to and hands-on experience with the high level of care and detail required to properly make and maintain preserved specimens and associated data. Natural History Collections Research Design is a discussion course based on primary literature readings that assesses the evaluation and development of research questions on topics including taxonomy, biogeography, ecology, and global change biology. These courses were first taught in Fall 2017 and Spring 2018 and will be taught again in the upcoming academic year. The presentation will include detailed aspects of topics covered

and mechanics of providing students with hands-on experiences. We will also present a summary of student evaluations of the courses and new strategies for implementing student-suggested alterations. Finally, variations on course credit-hour structure and content will be discussed based on different approaches taken among three collaborating institutions: Arkansas State University, Murray State University, and Southern Illinois University.

Keywords: education, coursework, teaching, collections

<https://osf.io/9bn8f/>

Rebuilding the Relationship between Science and Illustration through SFA (Science Finds Art)

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GS-02 General Session Poster Presentations

Scientific illustration is an integral, yet often under-recognized, part of scientific research and communication. As budgets continue to shrink, more and more illustrators find themselves out of full-time positions and have had to adapt to the new gig-based economy; working many small free-lance jobs at a time and often working remotely. This de-coupling of artists from a parent institution, such as a museum or research university, over the past few decades has made it more difficult for artists and scientists to maintain a dialogue and support one another. The difficulty and time required to find and collaborate with artists has made many in the scientific community begin to question the value of scientific illustration. To make the situation

worse, there is no centralized resource for scientists and communicators to use to find illustrators when they are interested in collaborating.

SFA (Sciencefindsart.com) was created to help combat this problem by providing a database of working scientific illustrator portfolios in a user-friendly, searchable online platform. Additionally, the website will serve as an online community designed to foster communication, support, and relationship-building among illustrators, scientists, and anyone interested in science communication with the hope that this can lead to new collaborations and exciting projects. SFA is currently in its early stages, but we have big hopes for what it could become in the future. We are currently exploring the establishment of a program that provides support for local scientific illustrators to lead workshops at science conferences to help rebuild the relationship between scientists and artists. The illustration workshop at SPNHC 2019 will be the first of these workshops and will introduce attendees to foundational ideas of representational drawing and discuss the advantages of collaboration between the arts and science.

Keywords: art, science, illustration, communication, collaboration

<https://osf.io/bf32q/>

Cretaceous World TCN: Digitizing the Western Interior Seaway at the Yale Peabody Museum

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SY-05 Managing And Digitizing Large Collections

The Cretaceous World Thematic Collections Network is a collaboration between Yale Peabody Museum (YPM) and Univ. of Kansas (lead), the American Museum Natural History, Fort Hays State Univ., Paleontological Research Institution, South Dakota School of Mines & Technology, Univ. of Colorado at Boulder, Univ. of New Mexico, and Univ. of Texas at Austin. This project seeks to digitize collections from the Western Interior Seaway (WIS), a shallow sea that covered the western portion of the United States 100-65 million years ago. These data will allow scientists to answer fundamental questions about this changing ecosystem, which are relevant to the modern challenges of our changing climate.

In the past two and half years, YPM has digitized nearly 88,000 specimens from the WIS. Specimens are georeferenced and many have multi-view images; all associated data is made available on iDigBio.org. Additionally, 48 specimens have been 3D scanned and placed on morphosource.org. To facilitate the use of these data by K-12 educators, the iDigPaleo platform (idigpaleo.org) was used to create a WIS-specific website (cretaceousworld.org), which serves as a user-friendly collections interface where students can access specimen photos, collection and locality data. Specimens can be found using specific search terms; navigation has also been made easier by utilization of common names harvested from the Encyclopedia of Life. Registration gives students and teachers access to annotation and measurement tools as well as the ability to curate and share their own collections. Images taken for the Cretaceous World TCN are also being utilized on Cretaceous Atlas (cretaceousatlas.org), a digital field guide

and educational tool about the organisms of the WIS.

Throughout the project, we have overcome the challenges of digitizing multi-specimen concretions and foraminifera microslides. We have developed high-throughput digitization workflows that incorporate the open-source software, InSelect, and home-grown scripts that streamline image naming and formatting for upload to our Axiell EMu database.

Undergraduate students from 5 institutions have participated in the digitization process and served as mentors for our high school internship (Peabody EVO) program.

This project was funded by the NSF Award #DBI-1601884 and #DBI-1645520

Keywords: Digitization, Western Interior Seaway, Thematic Collections Network, Cretaceous, paleontology
<https://osf.io/ypnwa/>

BIOSPEX 3.0—A Basecamp for Launching, Advertising, and Managing Biodiversity Specimen Digitization Expeditions

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GS-01 General Session Oral Presentations

Public participation (i.e., crowdsourcing, citizen science) in the digitization of biodiversity specimens is an appealing strategy for biocollection curators, since it enables them to simultaneously advance digitization, outreach, and sustainability goals. Several engaging sites for public participation now exist, including

Notes from Nature, which has had coordinated development with BIOSPEX over the past four years with joint funding through NSF's Advances in Biological Informatics program. To date, BIOSPEX-launched projects on Notes from Nature have resulted in a half-million specimen transcriptions by nearly 4,000 participants, with BIOSPEX providing engaging visualizations of progress (e.g., map of collection locations of transcribed specimens) and a central location to aggregate resources that enrich user experience (e.g., videos explaining the science). BIOSPEX 3.0 represents a compelling refresh of the user experience with the addition of new functionality, especially in support of classroom integration. This new functionality enabled the WeDigFLPlants project to pilot a team competition during WeDigBio 2018 that relied on a near-real-time BIOSPEX scoreboard. We will introduce the new BIOSPEX 3.0, scheduled for release in the weeks just prior to the conference.

Keywords: BIOSPEX, Citizen Science, Digitization, Education, Outreach
<https://osf.io/qjn6r/>

Strategic Planning for the Worldwide Engagement for Digitizing Biocollections (WeDigBio) Project

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SY-04 Crowdsourcing Digitization: Partnerships, Platforms, And The Worldwide Engagement For Digitizing Biocollections (Wedigbio) Event.

At present, the Worldwide Engagement for Digitizing Biocollections (WeDigBio) Project provides resources for biodiversity research collections to effectively and creatively engage their local communities and global internet users in digitization of specimens and associated content. This occurs most prominently during an annual, 4-day WeDigBio Event. Project organizers envision a future where large-scale creation of research-ready data continues with carefully crafted evaluation mechanisms guiding the community towards increasing science inclusiveness and participant understanding and valuation of biodiversity, biodiversity collections, and biodiversity science. Strategic planning for the WeDigBio Project began in 2017 and is expanding in 2019 to involve all major stakeholder groups. We will present a status report on the process, including the emerging plans for an external advisory board for the Project, a steering committee for the Event, Event ambassadors, and a leadership team with formally defined duties. We welcome everyone's input into the process.

Keywords: Citizen Science, Education, Outreach, Strategic Planning, WeDigBio
<https://osf.io/s9qxb/>

Time and Light: the Long Process of Daylighting an Iconic Paleontology Gallery

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GS-01 General Session Oral Presentations

Dinosaurs exhibitions draw audiences to natural history museums, and their galleries are some of the most beloved places in our communities. Lighting these iconic specimens is a critical part of telling their stories: museums want to show the scale of the animals, the intricacy of their structure, and their context within a distant

world. At the same time, these specimens require care to preserve their fossil material for research and for future generations of museum visitors.

This oral presentation explores the design process used to create Deep Time, the upcoming Paleontology exhibit at the Smithsonian National Museum of Natural History. Light was a critical consideration in the planning, design and construction of this space over an 8-year period as the museum and design team juggled notions of returning a strong sense of daylight to the historic gallery, identifying what portions of the specimens are vulnerable to light damage, reducing energy use and creating an environment where the public can enjoy and understand some of the most important pieces of the Smithsonian's collection. The project was a collaboration between lighting designers, engineers, architects, exhibit designers, conservators, collection managers, facility managers and curators. Early lighting modeling and material investigation set the stage for understanding and managing light levels in the conceptual phase of the project, and the direction continued to evolve through construction as the exhibit came to fruition. Flexibility and communications within the team were critical to the project's success, and the presenter will identify lessons learned for future projects.

Keywords: light, design, construction
<https://osf.io/9kryu/>

A Shout Out for Cultivated Plant Collections

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GS-01 General Session Oral Presentations

Herbaria come in many kinds and sizes, but all of them pose the same question about where their specimens originate to a user or a curator, and only a minority will include the word ‘garden’ in their answer. And yet there is a wealth of specimens of cultivated origin, both modern and historic, in herbaria all around the world. In addition, hundreds of thousands of collections have been made by horticulturists whilst hunting for new plants to introduce to our gardens.

A report in 2018 found that in the UK alone the ornamental horticulture and landscape industry contributed £24.2 billion (\$31 billion) to the economy in 2017 – equivalent to 1.2% of the nation’s total output. It also accounts for 1.6% of the total UK workforce (2018). The industry depends upon the stable and accurate naming of cultivated plants and this is where our herbarium comes in. As with botanical collections, a well documented and authoritatively named set of specimens is critical. But also, the means to make this resource accessible to the users. With this aim in mind we have recently completed the image capture of the 87,600 dried plant specimens in our herbarium (WSY) and plan to make these available online in the near future.

We believe that many specimens of horticultural importance lie buried in large botanical collections and suggest that these collections might tap into a new audience and find new users if they were able to make this material available through digitisation. Indeed, hidden in herbarium cabinets are likely to be specimens of ornamental plants that have the potential of being Nomenclatural Standards (which are to cultivars what Types are to wild plants).

References:

All-Party Parliamentary Gardening and Horticulture Group (2018). Securing the future of the garden and horticulture sector.

Downloadable here:

<https://hta.org.uk/government/appghg.html>

Keywords: Key Words: cultivated plants, herbarium, digitisation, Nomenclatural Standards, horticulture.

<https://osf.io/nsujd/>

Curation of the Florida Museum of Natural History’s Fluid-Preserved Mammal Collection: Lessons Learned for Future Curation Efforts

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GS-02 General Session Poster Presentations

The mammal collections at the Florida Museum of Natural History has over 34,000 catalogued specimens, 6,237 of which were listed in the database as fluid-preserved as of 2017. The fluid preserved collection contains everything from whole specimens to digestive tracts. At the beginning of the curation, it contained 18 orders, 72 families, and 233 genera. It spans 54 countries, including a large holding of over 1,700 rodents and insectivores from Pakistan. The fluid collection had been neglected for many years under previous management. A critical need was identified to rehouse all the specimens in 70% ethyl alcohol, install archival quality labels, and update taxonomy. After the fluid collection, the number of fluid-preserved specimens increased to 6,461. Of those, 176 were identified as being missing, 8 on permanent loan, 2 exchanged, 4 gifted, and 103 had been previously destroyed or discarded. The increase in the number of fluid preparations was due to either uncatalogued material found in the fluid collection or cataloged preparations that were not listed in the database (for example, fluid-preserved digestive tracts which could be linked to a skin/skeleton in the dry collection but had

not been recorded in Specify or its Access predecessor). Many specimens were still in formalin or isopropyl alcohol and were subsequently moved into ethyl alcohol. All jars received archival quality labels and fresh 70% ethyl alcohol. After updating taxonomy, we now have 17 orders represented (due to Erinaceomorpha and Soricomorpha being combined into Eulipotyphla). The number of families increased to 76 and the number of genera represented increased to 253. We also increased the number of countries represented, to 56. The biggest hurdle we faced was making labels in Specify, which required some compromises on data, due to the collecting event field not always matching in a series of specimens. We also had many instances of jars with non-consecutively cataloged specimens or specimens from different localities (although same county or geographic region), which we had to split into separate jars so they could get the correct labels. This led to an unanticipated need for many more jars and ultimately increased the footprint of the fluid collection. In the poster, we list some tips for those wishing to move forward with their own fluid curation.

Keywords: curation, fluid, preservation, mammals
<https://osf.io/ru8yp/>

Digitizing the Field Museum's Fossil Invertebrate Collection

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SY-05 Managing And Digitizing Large Collections

The Fossil Invertebrate collection at the Field Museum has an estimated 2 million fossil specimens divided into 350,000 specimen lots. The collection was built over the last 125 years by staff, with a wide range of research interests,

collecting specimens in the field and by donations from a variety of different sources. The focus of the collection is middle Paleozoic fossils of the Midwest.

The majority of specimen data are recorded in handwritten labels and catalog entries and to date only 20% of specimen lots (75,000) are digitized. These 20% are the result of multiple small digitization projects that focused on small parts of the collection.

Digitization of the collection started in the 1980's with an NSF grant that resulted in the creation of a Filemaker Pro database and the digitization of 30,000 Mazon Creek specimens. From the 1990's to 2011 there were a number individual efforts to add to the database and attempts to procure funds to digitize the entire collection and in 2012 the entire dataset was transferred to EMu. Following that a series of projects focused on digitizing targeted and regionally significant parts of the collection were funded. These digitization projects could be divided into three types:

- 1) Historic backlogs: 320,000 specimen lots that were collected and cataloged, but never digitized.
- 2) New collections: Specimens are continuously added to the collection and all new specimens are databased to avoid adding to the backlog.
- 3) Research digitization: For example, Tully monsters were already cataloged in the database, images and morphologic terms were added for a research project to help researchers measure and identify key specimens and adding to the richness of the existing records

Project results:
2012

- Volunteer project resulted in 633 records from the cephalopod type collection being digitized
- Staff project digitized 4,415 records from Ward's World Columbian Exposition catalog.
- Grainger Digitization Initiative resulted in 241 Mazon Creek type, figured and referred collection being digitized

2013-2016

- IMLS Silurian of the Upper Midwest Project resulted in 19,116 Silurian records being digitized.

2016-2017

- Women in Science interns digitized 5,493 Thomas V. Testa Specimens.

2018

- Women in Science project digitized 1,392 James and Sylvia Konecny specimens.

2018 to 2020

- IMLS project digitized 3,820 Ordovician records currently.

Keywords: Fossil Invertebrates, Field Museum, Digitization, Paleozoic, IMLS
<https://osf.io/53mp2/>

Colorful Crustacea: Restoring and Recoloring Crustacean Specimens for Permanent Display

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GS-02 General Session Poster Presentations

Specimens displayed in Natural History Museums should be as true to the real creature as possible in order to properly educate members of the public and serve as clear references. So what good would a case full of faded crustaceans do in

a completely new and permanent reference center?

As part of the grand reopening of the Discovery Centre at the Queensland Museum in March of 2019, myself and Alison Douglas (Taxidermist and Senior Preparator) restored and recolored over 30 museum specimens from Crabs to Barnacles to deep sea Isopods. Using alkyd paints and references provided by curators, each specimen was meticulously painted to match its real life counterpart. In this poster presentation, we hope to demonstrate the techniques used to breathe new life and color into these faded specimens and demonstrate the importance of using specimens that are as representative as possible in order to properly educate and engage the public.

Keywords: museum specimen, specimens, display, exhibition, crustaceans, restoration
<https://osf.io/jm3xh/>

The Arctos Ecosystem: Using Standardized, Predictable Data to Form Resolvable, Reciprocal Links to Related Internal and External Data Objects

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SY-03 Interconnectedness Of Data

Arctos is a community and museum collection management solution providing research-grade open data for 29 museums holding 158 collections. Arctos is based on a deeply relational, highly-normalized data model developed as fundamental research infrastructure for curators, collection managers, investigators, educators, and anyone interested in natural and cultural history. This structure creates data that are inherently more discoverable due to their predictability. Standardized, predictable data shared between institutions may be used to form resolvable, reciprocal links to related internal and external data objects, such as hosts to parasites, specimens to GenBank sequences, cited specimens to journal articles, and specimens shared between Arctos institutions. Reciprocal linkages allow for powerful cross-resource questions, such as “What parasites of *Canis* are documented in Arctos?” or “Show all specimen records in family Canidae that are hosts of parasites in family Taeniidae.” Arctos was the first collection management solution to develop reciprocal linkages between specimens and GenBank sequence data, thereby establishing the current standard for specimen-specific unique identifiers. Additionally, Arctos leverages external web services to extend capabilities. Taxonomic tables may be curated individually or shared with other collections and classifications can be created manually or through import from various resources accessed via GlobalNames. Collections can opt to use the integrated WoRMS taxonomy which includes all AphiaID’s and is continually updated. Integrated GeoLocate provides semi-automated georeferencing in Arctos and also allows transformation of coordinates into standardized descriptive searchable text via reverse georeferencing services. Specimens and media in Arctos have an inline “thumbnail map” dynamically generated via Google Enterprise tools. CrossRef and PubMed web services provide semi-automated

publication creation in Arctos. Stable URLs or IDs allow linking from Arctos specimen records to MorphoSource, Barcode of Life, BugGuide.net, GBIF, iDigBio, InvertEBase and iNaturalist. In this presentation, we will share the benefits and challenges of linking data as well as suggestions for connecting data via stable URLs and identifiers.

Keywords: linked data, data standardization, unique identifiers

<https://osf.io/4fp3a/>

Success Metrics in Arctos (and What We Hope to Build)

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SY-06 Collecting Measures Of Success

Arctos, an online collaborative museum collection management solution, is capable of providing its users with many metrics. Collection statistics, reporting features, data quality feedback and discovery tools aid Arctos users in improving data and quantifying collections use and impact. But how many of these metrics are metrics of success? Success metrics require up-front planning and ongoing development as indicators of success change and expand over time depending upon community, stakeholders, and institutional norms. Many of the metric tools available in Arctos were created by request of an individual collection in isolation from other tools and often placed in proximity to the data table(s) with which they are associated (e.g., transactions, citations), over time becoming scattered across the Arctos landscape.

In this presentation, we will demonstrate some of the tools developed, either purposefully or by accident by the Arctos community and discuss the ongoing development of a central collection dashboard. By bringing performance metrics together in one place we hope to help Arctos collections better comprehend, visualize, and communicate their holdings and activities, both quantitatively and qualitatively. The dashboard will also compile data quality improvement opportunities to participating collections, including automated suggestions to enhance data integrity and linkages. We will also seek advice from the audience on which metrics might be most useful to the community in general or what metrics might be missing.

Keywords: metric tools, dashboards, data quality
<https://osf.io/guk9v/>

Arctos: A Tool to Help Small Collections Make Their Case

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SY-13 SCNet Symposium: No Collection Left Behind: Research Contributions of Small Collections

Small collections are often challenged when it comes to information management, accessibility, and ability to demonstrate their importance to institutional administrators. Arctos, a web-based

collaborative museum collection management solution, is an affordable way to meet these challenges. In this presentation, we will demonstrate how Arctos has been used by small collections to make a contribution to the global biodiversity infrastructure, both through collection-specific data portals and via data aggregators such as GBIF and iDigBio. We will also review some of the powerful tools available in Arctos that allow investigators to ask research grade questions of the data that are housed in small collections, and allow collection managers to document and report on the research impact of their collections. Arctos offers the additional advantage of being a collaborative system, where collection managers from both large and small institutions work together to ensure data quality and usability for all. This collaborative community helps to break down barriers that traditionally have caused managers of small collections to feel isolated from the broader collections and research communities.

Membership in Arctos immediately provides collection managers with a network of peers who will provide feedback on all aspects of collection management. We will review the ways in which Arctos members interact and we will demonstrate how sharing the work of managing collections lessens the workload and ensures higher quality data for the entire community.

Keywords: community, accessibility, research-ready data

<https://osf.io/zhjvs/>

Transforming Accession and Field Books at the Illinois Natural History Survey Insect Collection into Powerful Metadata Depictions

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SY-05 Managing And Digitizing Large Collections

The Illinois Natural History Survey Insect Collection (INHS-IC) has a small (ca. 50 volume) collection of specimen accession and field notebooks that document a significant proportion its over 7 million specimens, especially historical material. While some of these ledgers have been transcribed previously, the books themselves have not been scanned or digitized, and the aging ledgers often need to be checked against the transcriptions in our database, creating preservation issues. In partnership with the University of Illinois (UIUC) Library, UIUC Archives, and the Biodiversity Heritage Library, the INHS-IC has begun digitizing our accession ledgers and field notebooks to create a digital surrogate to reduce handling of the accession books, which are permanently deposited at the UIUC Archives. Furthermore, in the process of transitioning to a more powerful collection management system capable of handling images, TaxonWorks (taxonworks.org), we gained the capacity to add fine grained annotations to scanned images, which prompted a further question. What, exactly, is being depicted in images of ledger and field notebooks? While a depiction of a fieldbook collecting event contains information on collecting objects, events, collectors, and other metadata, an image of an accession book is not a depiction of any of those things, but is a depiction of archival natural history metadata. Therefore, these digital surrogates have been injected into a powerful new “metadata depiction” within TaxonWorks that allows for in-database quality checks via linked ledger entries. The depiction of the accession or field book can be linked to multiple kinds of annotations, allowing for robust quality control prompted by the software itself and a provenance

trail within any record that links to that metadata depiction. In the long run, this will lead to increased digitization speeds and higher information quality for undatabased specimens documented in historical accession and field notebooks.

Keywords: digitization, collection management, annotation, preservation
<https://osf.io/ysebX/>

Extra-Terrestrial Conservation: Storing the Cranbourne Meteorites

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GS-02 General Session Poster Presentations

The first of the Cranbourne meteorites was unearthed in 1853 and was at the time the largest iron meteorite in the world. Since this time 12 more specimens have been uncovered, the latest in 2008. The specimens in the Museum Victoria collection range in size from 14 g to 1500 kg. The composition of these meteorites and the conditions of their burial have resulted chemically unstable specimens which require specialized storage to prevent them deteriorating. This poster will address the challenges of creating desiccated and anoxic storage for these large iron meteorites.

Keywords: conservation, storage, meteorites
<https://osf.io/5u4rt/>

How Disturbance History Affects Lichen and Bryophyte Diversity in Two on-Campus Old Growth Forests

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SY-15 Broadening Participation of Students in Biodiversity Collections through a Network of Student Clubs

Old-growth forests are unique habitats often characterized or identified by their lichen and bryophyte diversity. Although these taxa are used as indicators of old-growth conditions, little is known of the impact disturbance has on their diversity. We compared and contrasted cryptogam diversity in two old-growth forest tracts on the Virginia Tech campus in Blacksburg, Virginia, to quantify disturbance impacts. Stadium Woods is located on the main campus directly adjacent to the football stadium, where it has experienced significant amounts of use from football patrons, forestry students, the corps of cadets, and briefly served as a housing area for veterans. Another stand, Center Woods, is offset from the main campus and has been mostly used by the wildlife department for various research projects over the years, experiencing much less disturbance than Stadium Woods. Both tracts are dominated by oaks and northern hardwood species such as *Quercus alba*, *Quercus rubra*, *Acer rubrum*, and *Prunus serotina*. These tracts are remnants of the same original contiguous forest that once covered the Blacksburg area prior to European colonization. Stadium Woods and Center Woods provide an opportunity to compare how the history of disturbance in these forests has affected lichen and bryophyte diversity. We used PerMANOVA and a two-step cluster analysis to quantify disturbance effects on cryptogam abundance in these two old-growth forest tracts. This study has documented the first occurrence of two hepatic species, *Pallavicinia lyellii* and *Chiloscyphus cuspidatus*, in Montgomery County, Virginia. Our results will further document the understudied Virginia cryptogam flora and have important ramifications for old-growth forest assessment and ecology.

Keywords: forest ecology, old-growth forest,

cryptogams
<https://osf.io/cz96g/>

Connected to the Community: Managing and Preserving Natural History Specimens with Strong Cultural or Emotional Links to the Public.

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GS-01 General Session Oral Presentations

Natural history collections can and are utilised to provide researchers and the public with information about the world around us and, of course, our impact on it. Museum staff and scientific researchers are regularly encouraged to promote the importance of natural history collections and their significance to the community. However sometimes the significance of a specimen or even a species comes not from within the museum sphere but from the community.

The public may give a particular specimen a name, formally or informally. The story of a particular animal before it became a museum specimen may have a strong resonance to the people of a particular area, while some species may have an enduring cultural relationship with a certain section of the community. Whatever it's origin the value put on such specimens by the public should not be under estimated.

The paper will explore the impact that such connections between specimens and the community can have on how we preserve and manage natural history collections. The authors will outline how such connections are

recognised, navigated and integrated into the workflows of the natural science and conservation staff at Otago Museum. Highlighting how such links can be respected while still acknowledging the science value and potential of natural history collections.

Keywords: Collection Management – Conservation – Community - Significance
<https://osf.io/udgsk/>

Championing Overlooked Information: The Importance of Collecting Routine Data Relating to the Preparation or Analysis of Natural History Specimens.

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GS-02 General Session Poster Presentations

Data is essential to Natural History collections in museums. Knowing who collected a specimen, when and from where is considered vital information. Indeed the significance of individual specimens is often strongly associated with the presence or absence of this provenance data. This data is also vital to the researchers that access museum collections. But what about data on the techniques and processes used by collectors or depositing researchers before items reach the museum?

Researchers and museums are understandably focused on the results of new scientific research arising from natural history collections and the natural world. However as part of managing and preserving natural history collections at Otago Museum the more ‘mundane’ or routine data relating to the preparation or analysis of specimens prior to entering the museum

collection has often found to be lacking or skeletal at best.

Standard preparation techniques or individual researcher processes may be well known at the time they are undertaken but over a specimen’s lifetime in a museum this ‘obvious’ knowledge may be lost as staff change or science moves forward.

In this poster the authors look at how this often overlooked data can provide a wealth of information that can feed into and even direct collection management and preservation programmes. The poster will highlight the active approach Otago Museum staff have taken when working with researchers and other depositors to raise awareness about the importance of this type of information and to ensure that all data however routine or seemingly obvious is collected and recorded.

Keywords: Data - Collections Management - Collaboration - Preservation
<https://osf.io/3qb6w/>

The Symbiota Sequence Submission Tool

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SY-03 Interconnectedness Of Data

The Symbiota biodiversity data management system is utilized by over 760 natural history collections worldwide to serve primarily

specimen-based content online. These collections, which encompass algae, bryophytes, fungi, invertebrates, lichens, plants, and vertebrates, are organized into 43 portals which serve ~37 million specimen records. Specimen records can be linked to images, tissues, species information, and DNA sequence data. Although specimen metadata have been assembled in several collection management systems, integration into pipelines for serving this metadata (i.e., referred to as source modifiers in GenBank) when submitting DNA sequence data does not exist. Biologists from all fields have done a horrible job at providing source modifiers to genetic databases (e.g., GenBank) during sequence submission. Nearly all GenBank sequence records of fungi, insects, plants and vertebrates lack the most basic source modifiers including specimen voucher or strain information that ties the genetic data back to the source from which they were derived. A new Symbiota Sequence Submission Tool (SSST) has been developed to automatically populate source modifiers during sequence submission and includes a unique structured comment specifically designed for each portal, thus greatly improving the integration and completeness of specimen and genetic data.

Keywords: data integration, genetic data, specimen metadata

<https://osf.io/hv2mb/>

Data Collection and Conservation at Two Late Triassic Bone Beds

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GS-02 General Session Poster Presentations

Perhaps one of the more pressing issues in the curation of paleontological specimens is the standardization of data collection methods. A 2018 excavation of Triassic fauna in Wyoming served as a case study for the collection of field data with the aim of to maximizing efficiency, as well as minimizing the loss of information. The methods themselves are two-fold: an on-site grid system, and a subordinate in-jacket mapping system. The first bone bed—a mass-death assemblage of metoposaurids—involved traditional excavation techniques. The on-site system utilized a six meter by three meter grid to assign jackets and individual elements field identification numbers. These numbers were entered physically into a journal and digitally into a database using a standardized note-taking method. Each grid square at the site is partitioned into smaller, subordinate grid squares within each jacket. As elements are removed in the preparation lab, they are assigned identification numbers according to their position in the grid. This system allows jacket elements to be returned to the larger context of the site, and minimizes data loss during preparation. The second bone bed—a time-averaged assemblage of a fossorial stereospondyl—involved surface collection of preserved burrow infills. A majority of these burrow casts were found to contain fossilized remains. Physical preparation of these specimens is complicated by small size and specimen stability. To advance the study of these animals, micro-CT scans are processed through Dragonfly 3D Software and segmented, producing a digitally prepared specimen. This process of digitally preparing specimens will be ambitiously extended to over three dozen burrows. These digital files become born digital specimens themselves, introducing new challenges in curation. Each physical specimen is associated with micro-CT files, digitally segmented files, and 3D object files, all of which must be tied to each burrow's specimen record.

Conserving these files and maintaining their association with the physical specimen presents potential complications in the preservation of data. These methods will be refined and field tested in future excavations.

Keywords: Curation, collection, methods, data, conservation

<https://osf.io/ernqs/>

Patchwork Patterns and Widescale Worth: Small Paleontology Museums Are Local Linchpins

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SY-13 SCNet Symposium: No Collection Left Behind: Research Contributions of Small Collections

Some in the scientific community feel a museum's importance is measured by its size, and that only big museums should be funded. Justifications include that funding given to small museums doesn't go as far and that small museum holdings are redundant with those of big ones. These naysayers myopically focus on the research function of museums, dismissing their vital role as centers of outreach and education. Thus, this presentation is on the key role small museums play in scientific research through examples from paleontology, a field where the importance of small museums is more widely accepted.

Some museums are physically tied to remote sites that must remain in situ. Remote museums are almost always small. The Peace Region Palaeontology Research Centre has three staff and stewards dinosaur trackways. Their ~4000 specimens include the holotype of the only known fast-swimming coelacanth and the widely-shared first evidence of gregariousness in tyrannosaurs.

The biosphere is not limited to the surface. Rocks deep underground represent millions of years of unsampled time. Non-profits are rarely able to afford drilling operations, but oil companies donate micro-and macrofossils from drill cores they no longer need—typically to local or regional repositories. The UC Riverside Earth Sciences Museum, a collection of ~250K specimens managed by one part-time staff, received an NSF digitization grant in large part due to their Shell Oil collection of Cenozoic marine invertebrates from drill cores in California.

Researchers donate to institutions they have ties to—including small institutions. The Indiana Geological & Water Survey has a small collection. Part of it (and of the associated mid-size IU Paleontology Collection) is millions of conodont elements documenting Indiana's biostratigraphy. They were collected and described by Carl Rexroad, a world class conodont researcher.

The fragmentary nature of the fossil record is mirrored in the by-necessity fragmented nature of its collections. The vastness of geologic time means inarguably unique types from local areas are held in most small collections. Ignoring that and sequestering resources into big museums is like deciding only papers published in *Nature* and *Science* are good research. To ensure all data are available, small paleontology collections must be funded.

Keywords: advocacy, small museums, research

<https://osf.io/vy3xk/>

Measuring Success for Collections: Educational Products and Outcomes

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SY-06 Collecting Measures Of Success

Natural history collections and the mobilization of specimen-based data has opened new opportunities for education. Collections, and the data associated with collections, are valuable resources that can facilitate student learning, address core competencies and content recommended by Vision and Change, and be used to teach valuable skill sets necessary for the 21st century workforce. Professionals working in and with natural history collections are developing educational materials and providing impactful student experiences; these are important collections-based deliverables that can be assessed, tracked, and published to show significant outcomes and outputs of collections. We will present survey results from students working in collections that support the value of museums and museum experiences in undergraduate education. We will discuss emerging competencies and assessment tools that can guide the introduction of collections in the classroom. We will also discuss mechanisms to develop and disseminate educational modules, track access and downloads of developed modules, and record educational adaptations of materials through the National Science Foundation funded BLUE Network: Biodiversity Literacy in Undergraduate Education (Biodiversityliteracy.org) and Quantitative Undergraduate Biology Education Synthesis (Qubeshub.org). In summation, we will introduce upcoming opportunities to develop, assess, publish, and facilitate implementation of educational materials that engage students with museum specimens and biodiversity data.

Keywords: Education, Assessment, Open Education

Resources
<https://osf.io/yxh64/>

The Role of Small Collections in Biodiversity Research

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SY-13 SCNet Symposium: No Collection Left Behind: Research Contributions of Small Collections

Smaller, regional biodiversity collections make valuable contributors to the digitization of collections and are uniquely equipped to enhance the quality and quantity of digital data representing global biodiversity. A recent Biodiversity Collections Network survey indicates a community-wide priority is to engage more collections in the national digitization effort. Toward this goal, there is a need to evaluate the role of small and regional collections in quantifying biodiversity and determine best practices for engaging this portion of the biodiversity collections community. This talk will provide some information on small collections and provide an overview of the growing role of small collections in biodiversity research. This talk is an introduction to some recent data and evidence that show the impact of small collections and some of the success stories for integrating data and engaging curators from these regional museums and herbaria. The goal is to highlight data-driven examples of the contributions small biological collections make to the national digitization initiative and resultant biodiversity research.

Keywords: Digitization, Small Collections, Biodiversity Research
<https://osf.io/3vf8u/>

Fossil Digitization Internships of Ordovician/Silurian Collections of the Field Museum and Milwaukee Public Museum.

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GS-02 General Session Poster Presentations

As part of an IMLS-funded, cooperative effort between the Field Museum and the Milwaukee Public Museum to convert existing paperbased Ordovician and Silurian fossil collection catalog records to digital form, students from the University of Wisconsin-Whitewater were hired as interns during the summer of 2018. The data technician-type internships involved work with museum specimens, photography, paleontologic/geologic data and the museums' collection management system(s) to chronicle the Great Ordovician Biodiversification Event (GOBE) and the Ordovician Mass Extinction. Internship work products for the Milwaukee Public Museum (Rasch – 1422 catalog records + 2492 multimedia records) and the Field Museum (Miller – 1079 catalog records + 3082 multimedia records) will form part of an online database, useable for researchers, teachers and students, as well as the general public. The training provided by these internships is invaluable in the STEM training of students from Primarily Undergraduate Institutions (PUIs), such as UW-Whitewater, where the number of specimens, research facilities equipment and professional mentors is typically limited.

Keywords: Digitization, Ordovician, PUI

<https://osf.io/2pk48/>

Digitization and Management of the National Museum of Natural History, Invertebrate Zoology Collections: Challenges, Workflows, and Solutions

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SY-05 Managing And Digitizing Large Collections

At approximately 50 million specimens, the Smithsonian Institution, National Museum of Natural History, Department of Invertebrate Zoology has one of the largest collections of invertebrates in the world. The department was founded in 1856 to house collections from the North Pacific Exploring Expedition. Today, staff host over 200 visitors and process approximately 600 transactions a year; manage five US Federal Government affiliated agency partnerships; and concurrently operate numerous collection improvement and digitization projects. Recent large projects include inventory of the National Mollusk and Brachyura (crab) collections; curation and reorganization of the US National Parasite Collection; processing of large voucher and genomics collections; digitizing analog station data; uncataloged collections resolution (Backlog Inventory and Exemplar Data Capture); planning for the Dry Mollusk Reorganization and Move; and MSC glass slide reorganization and move. Key challenges include organizing and accounting for all of the resources (knowledge, staff, equipment, time, space, collection supplies, funding) required for the project. It is important to include all of the stakeholders (communication!), maintain flexibility, and plan carefully and thoroughly. Effective solutions include organization and tailoring of workflows to specific projects with

constant reevaluation and documentation to minimize cost and maximize efficiency.

Keywords: Invertebrate, Digitization, Solutions
<https://osf.io/evf3r/>

The Largest Terrestrial Arthropod Collection in the Philippines: History, Status and Prospect

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GS-01 General Session Oral Presentations

The University of the Philippines Los Baños Museum of Natural History holds the largest collection of arthropods in the country. The museum's entomological collection holds around 300,000 specimens of pinned, slide mounted, and alcohol preserved insects and arthropod specimens. Collections date back to the institution of the university in the early 20th century, and is now made up of specimens from collection expeditions, biodiversity studies, and student submissions. Presented in this paper are challenges we face in maintaining the collection and the localized strategies implemented to address these. We also present future plans to upgrade the digitization of the collection and mobilization of data.

<https://osf.io/jswhr/>

Processing Historic Backlog: Lessons Learned

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GS-01 General Session Oral Presentations

Nearly all herbaria have backlogs of unprocessed specimens, often of sizable and overwhelming proportions. However, many herbaria may not have sufficient staff, resources, or funding to process their backlogs, and consequently, specimens of historic and scientific importance remain inaccessible to current and future research. Herbarium staff at Rancho Santa Ana Botanic Garden (RSA) consistently strive to make progress in processing backlogged specimens while simultaneously processing newly arrived specimens in an effort not to augment the backlog further. In 2016, RSA received a 3-year NSF Collections in Support of Biological Research grant (NSF DBI 1561648) to process 30,000 of the total 50,000 plant specimens in backlog storage. Specimens of utmost importance to process were those collected by ten notable botanists who had made significant contributions to the study of plants. Efforts to process and digitize these collections were largely undertaken by graduate students and undergraduate interns. The development of workflows for processing specimen backlog facilitated efficient processing, curation, and digitization of each botanist's collection. Curation of these important collections has: (1) provided physical and digital access to collections previously unavailable for study; (2) added immensely to the taxonomic and geographic breadth of the RSA Herbarium; (3) permitted discovery of type specimens thought to be lost; (4) ensured stabilization and preservation so critically needed; and (5) provided training and valuable hands-on experiential learning for undergraduate interns and graduate students. In this presentation, we share our insights and experience in obtaining funding to process backlog as well as best practice approaches, strategies, and methods in curation and digitization of important historic collections. Specifically, we will: (1) provide some guidance for how to obtain funding for backlog projects;

(2) offer alternatives when resources, staff, and funding are limited; (3) provide a general workflow and modifications to that workflow depending on the level of backlog processing required; (4) discuss strategies, problems, and pitfalls in processing historic backlog; and (5) cover the importance of student recruitment in natural history collections projects. As collections of historic importance are critical to advancing research and to our understanding and preservation of biodiversity, our goal is to share what we have learned with collections managers and to facilitate the process of tackling backlog projects.

Keywords: herbarium, historic backlog, project funding, student recruitment
<https://osf.io/kgqad/>

Incorporating Technology and Multidisciplinary Thinking into University Collections

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SY-15 Broadening Participation of Students in Biodiversity Collections through a Network of Student Clubs

Collaboration between museum collections and seemingly disparate fields of study has allowed for the expansion of many areas of research and the opportunity to find new uses for technologies to revolutionize the role of collections. Technical illustration and digitization has vastly increased accessibility to specimens and, in turn, enhanced their value for research and education. Additionally, by opening up collections to

people from fields outside of the intended discipline, many opportunities for research, innovation and potential funding may arise. However, the future of museum collections is marred with uncertainty, as collections struggle to keep pace with growing staffing costs and storage requirements. It is clear that museums must abandon the business-as-usual mode of operation in favor of more innovative strategies if they are to survive in modern times. Universities are an incredibly important resource for gathering these new interdisciplinary perspectives. Collaboration among individuals from various fields of study can generate new thought processes and open the door for endless opportunities for education, outreach and research. A case study that incorporates this idea of incorporating technology into collections is through digitization and 3D printing of specimens. CT and surface scanning provides high-resolution 3D images of an object's interior without damaging the specimen, opening up myriad new research applications. During my time in CurVinci, a residential Living Learning Community, I received training and experience working in an engineering dominated makerspace that involved 3D printing. My experience with these technologies are being applied to the Virginia Tech vertebrate collection with Dr. Carola Haas and George Brooks. I am surface scanning and 3D printing specimens to supplement species lacking representation in the collection, and for use as teaching aids and loan kits for the K-12 and undergraduate classes. Additionally, scans can be uploaded to online repositories, and accessed from anywhere in the world. New technologies and the incorporation of seemingly dissimilar fields of study are beginning to reveal the true potential of museums. Millions of preserved specimens, representing centuries of collecting, are just waiting to be unlocked.

Keywords: Collaboration, Interdisciplinary studies,

Research, Digitization, 3D Printing, University,
Technical Illustration

<https://osf.io/g9d67/>

Defining the Purpose of Public Participation Events: The Key to Desired Outcomes

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SY-04 Crowdsourcing Digitization: Partnerships,
Platforms, And The Worldwide Engagement For
Digitizing Biocollections (Wedigbio) Event.

The phrases public participation, crowdsourcing, citizen science, and museum volunteer activity are often used somewhat interchangeably to denote programs, projects, or events staffed by unpaid non-professionals who have sincere interest and passion in contributing to one or more museums or to collective museum projects. While the meanings of these phrases overlap in several ways, they refer to quite different types of events. Taking the time to align the desired outcomes of a proposed activity to the precise definitions of each of these activity types will more readily ensure success in achieving your goals.

Keywords: public participation, crowdsourcing,
citizen science

<https://osf.io/6sugq/>

Resources Display Unit: Past, Present and Future

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SY-10 Storage Techniques For Art, Science, And History
Collections (STASH) Preventive Conservation And
Storage: STASH Flash II

In the early 1990's SPNHC created the Resources Display Unit (RDU) to feature recommended materials and resources for collections preservation. Designed to be easily packed and shipped, the RDU travelled to professional meetings and workshops for many years. The Conservation Committee is working to update the RDU by aligning with the Materials Selection and Specification Working Group (MWG.) This talk will review the history of the RDU and include time for discussion about how best to integrate it with the exciting MWG work.

Keywords: RDU, MWG, Materials

<https://osf.io/p3jr6/>

Ring Mounts on Boards

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SY-10 Storage Techniques For Art, Science, And History
Collections (STASH) Preventive Conservation And
Storage: STASH Flash II

Ring mounts are a handy solution for supporting round bottomed objects like ceramic vessels. Securing rings to boards increases the mount's usefulness. The boards are slightly larger than the object, allowing for tight yet safe storage. The boards ease handling and tracking when marked with identifying data. The rings can also be formed into irregular shapes when glued to a board, providing better support for irregular objects. In this STASH Flash talk, I will discuss tips and tricks for working with polyethylene backer rod and acid free corrugated cardboard. I will also show variations on the mount for fossil and mineral collections.

Keywords: STASH Flash, Ring mount, Backer rod

<https://osf.io/r6q24/>

Using Neodymium Magnets to Hang Horizontal Mounts in Steel Cabinets

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SY-10 Storage Techniques For Art, Science, And History Collections (STASH) Preventive Conservation And Storage: STASH Flash II

When we moved our bird collection out of old wooden cabinets and into new powder-coated steel cabinets, we were at a loss as to how to accommodate the birds mounted on horizontal branches. L-shaped hooks protruding from the branches had attached to brackets nailed to the old cabinet walls. After considering unsuitable and cost-prohibitive alternatives, including metal pegboard and custom steel-panel inserts, I began testing magnets of varying strengths and discovered that neodymium magnets work well to attach the old metal brackets to our new metal cabinet walls. Our wall-perching birds are now secured inside steel cabinets by disc or block neodymium magnets ranging in thickness from 1/16 to 1/4" and in pull from 6 to 23 lbs.

Keywords: storage, mounted specimen, horizontal perch, magnet, neodymium

<https://osf.io/mtv2c/>

Cataloging the Antarctic Fish Collection of Joseph Eastman

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SY-07 Interns And Young Professional Showcase (Poster Session)

Professor Joseph Eastman of Ohio University spent decades, from the 1970's until the 2010's, research the Notothenoid fish of Antarctica. On

numerous trips to the Antarctic, and through diverse correspondence with other leading experts in the field, he developed an extensive collection of Antarctic vertebrate collections, including fluid-preserved specimens, skeletons, cleared and stained specimens, histology slides, and x-ray radiographs. Professor Eastman cited many of these specimens and archives in his prolific published work on Notothenioid biology and Antarctic fish diversity. In recent years, he donated the bulk of this collection to the Yale Peabody Museum of Natural History. Combined with the existing collections at the Peabody, this addition has rendered the Peabody's collection of Antarctic fish the most comprehensive in North America. Since June of 2018, I have been developing a catalog of this extensive, invaluable collection, generating physical and digital finding aids and adding to the Peabody's searchable database. Professor Eastman's work constitutes one of the most important corpuses of Antarctic fish research, and turning his influential work into an accessible catalog for future generations holds the promise of unlocking future discoveries in the realm of Antarctic biology.

Keywords: zoology specimens, fish, fluid preservation, database, x-ray, archives, research, histology

<https://osf.io/8yx56/>

Hunting Fossils Online to Donate to Museums and Discover New Species

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GS-01 General Session Oral Presentations

We are two students who have joined our family in hunting for rare fossils online to donate to museums and help discover new species. We

search websites to find interesting specimens for sale and seek out paleontologists who would like to study them. We then buy the fossils and donate them to museums and university collections. So far, we have donated more than 150 specimens to museums including the National Museum of Natural History, the American Museum of Natural History, the Natural History Museum of Los Angeles County and the Field Museum. Scientists have described more than 20 new species, including fish, insects and arthropods. Many more are being studied.

As part of our efforts, we've started working with curators to learn what they're most interested in adding to their collections. That allows us to concentrate our efforts to find those particular specimens.

We hope to connect with more curators in the coming months. Our ultimate goal is to get as many important specimens into museums as we can.

Keywords: Citizen scientists, discover, fossils, new species, online, donate
<https://osf.io/f7nx8/>

Curating the Anderson-Cutler Maize Collection: Problems and Solutions

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GS-02 General Session Poster Presentations

The Anderson-Cutler Maize Collection at the Missouri Botanical Garden consists of about 8,600 specimens gathered by many different collectors from the early 1900s to the 1950s from localities around the world. Currently, a project is underway to curate the specimens in the Anderson-Cutler Maize Collection to a high standard according to modern best practices

using archival materials for safe and long-term storage, database the associated metadata, and image the accessions. In recent years, this collection has not been studied or utilized, and many specimens need more thorough documentation and research to reconstruct provenance and historical usage. Completing the project will enable future research studies to be built on the strengths of the collection. This will also provide an opportunity to train students in curation techniques as well as increase their familiarity with the economically important taxa present in the Garden's herbarium.

The collection may be unique in its diversity, including maize collected by the USDA from the early 1900s to 1930s, maize grown in the U.S. before the development of hybrids, and a wide range of specimens representing many of the varieties or landraces grown by indigenous societies in the Americas. It is certainly one of the largest and most diverse historical maize collections in existence.

Due to the significance of maize as a global food crop, this diverse collection has great potential scientific importance, and needs to be made available for further research involving maize domestication and its historic usage. Every effort should be made to thoroughly document and properly house all specimens following the highest possible curation standards.

This collection, especially if rare or unique landraces are identified, could be a source of genetic material useful in creating new hybrid varieties capable of growth and survival under diverse conditions. The collection also contains an extensive historical teosinte subset, including many of geneticist George Beadle's hybrids, which might provide valuable insight in the study of maize domestication. In addition, information on traditional landraces of maize historically grown in the Americas would

undoubtedly be of interest to indigenous cultural groups attempting to revitalize their knowledge and use of traditional food crops.

Keywords: Maize, herbarium collections, curation solutions
<https://osf.io/b3evj/>

Making Hay while the Sun Shines at the University of Puerto Rico Museum of Zoology

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GS-01 General Session Oral Presentations

Since its foundation in the 1940s, the Museum of Zoology at the University of Puerto Rico Río Piedras Campus has served as the largest natural history collection in Puerto Rico. During its heyday, the Museum was attracting thousands of visitors per year. However, for reasons unknown, activity nearly ceased soon after, only for the Museum to reemerge decades later as a repository for research. Now, new attempts are being made to expand and reorganize the collections, digital infrastructure, research collaborations, and internal as well as external outreach capabilities. This work has been a slow process, hampered by the passage of Hurricane Maria and lack of steady funding. Nevertheless, through continued grassroots expansion and perseverance of its limited staff, for the first time in its 75 years, the institution is beginning to fully blossom again. History has taken the Museum through substantial changes to its location, resources, funding, and purpose. Our

recent success in engaging scientists and thousands of students at all educational and socioeconomic levels in Museum activities once again reaffirms a path forward and a renewed purpose for the preservation and presentation of Puerto Rican and Caribbean biodiversity.

Keywords: outreach, Puerto Rico, small collections, Caribbean, zoology
<https://osf.io/5x6nb/>

Informing Undergraduate-Led Outreach Activities through Ethnobotanical Research on Medicinal Plants in Colonial Virginia

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SY-15 Broadening Participation of Students in Biodiversity Collections through a Network of Student Clubs

The collision of three distinct cultures in colonial Virginia represents an ideal scenario to quantify medicinal plant diversity and cultural exchange while contributing a fertile source of ideas for informal outreach activities. We documented the medicinal plants used by Native American tribes (e.g., Powhatan and Rappahannock), European settlers, and African-American slaves during the colonial period (1607 – 1776 C.E.) of Virginia from peer-reviewed literature, ethnobotanical databases, and historical documents. We will analyze a phylogeny including all compiled medicinal taxa in PHYLOCOM. We will identify “hot nodes” that are overrepresented with medicinal species, which could exhibit promising candidates for biomedical inquiry. We will also determine the similarity of medicinal floras among the three cultures. This project adds a new dimension to our historical knowledge of medicinal plants and cultural exchange within colonial Virginia. Furthermore, this research is

also used to identify suitable species for our “VTea” outreach program. VTea is a biweekly event created and organized by Virginia Tech Massey Herbarium students. The event focuses on educating students and staff about the local, native plants of Virginia through the lens of herbal teas. We also educate the public on the monthly featured species’ ethnobotanical uses, chemical composition, and other notable traits or history. Participants experience their connection to the local environment by indulging in a cup of their local history and have the opportunity to recognize the importance of plants throughout time. This coupling of undergraduate ethnobotanical research and outreach activities is a creative model for student-led activities in natural history museum collections.

Keywords: ethnobotany, phylogenetic diversity, outreach

<https://osf.io/h2gvk/>

Inclusion of Fieldwork and the Curatorial Process into a STREAM Girls Summer Camp

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GS-02 General Session Poster Presentations

The prevalence of STE(A)M (Science Technology Engineering (Arts) and Math) camp opportunities for children and young adults has increased in the last decade. The Palouse-Clearwater Environmental Institute (PCEI) has implemented several such week-long summer camps that also incorporate restoration, such as planting native vegetation, thereby designating them as a STREAM camp. The STREAM camps are geared towards girls entering 7th, 8th, or 9th grade as this is known to be a critical time to maintain interest in the STEM fields. For the 2018 STREAM week, one major goal was to

incorporate opportunities for the participants to learn diverse hands-on STEM skills, which included field collection techniques and the creation of voucher specimens for museum collections. The participants practiced field collection techniques, collected plant specimens, learned about plant identification, mounted plant specimens, and learned about digitization efforts and the importance of museum collections like herbaria during a tour of the Stillinger Herbarium at the University of Idaho. All of these hands-on opportunities were led by female scientists employed at the University of Idaho. The six participants created voucher specimens that were added to the Stillinger Herbarium and are publicly available through the Consortium of Pacific Northwest Herbaria (www.pnwherbaria.org). Through this process, the girls were able to interact with mentors, gain new hands-on STEM skills, experience the curatorial process, and broaden their knowledge of possible STEM career paths.

Keywords: outreach, STEM, herbaria

<https://osf.io/smw5z/>

Small Collections in the Era of Big Data and ADBC

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SY-13 SCNet Symposium: No Collection Left Behind: Research Contributions of Small Collections

Members of the biological and paleontological collections community came together and developed a ten-year strategic plan to digitize, image, and mobilize biodiversity collections data

(http://digbiocol.files.wordpress.com/2010/08/niba_brochure.pdf) and followed this strategy with an implementation plan (<http://www.aibs.org/public-policy/biocollections.html>). The goal of the proposed digitization effort is "to produce a resource of lasting value for answering major research questions." The Advancing Digitization of Biodiversity Collections (ADBC) Program solicitation that started in 2011 represents a response to the community's call for action and provides seed funds to begin the process of digitization for non-federal collections in the U.S.. Integrated Digitized Biocollections (iDigBio) was created as the national resource for ADBC program. iDigBio serves many roles including as a data mobilizer and aggregator and also as a community workforce resource offering professional development in the form of workshops and webinars and curating digitization best practices and recommendations online through idigbio.org.

In this presentation we will summarize the role that U.S. 'small collections' have played as ADBC participants and data providers over the past 8 years of the program. We will also examine how iDigBio workforce training efforts have impacted digitization and data mobilization of small collections. Have small collections gotten their due support or have they been largely left out of the digitization effort and what should be our next steps forward to make sure no collection is left behind?

Keywords: small collections, digitization, data, workforce training
<https://osf.io/wkj3c/>

To Connect is to Preserve: on Frugal Data Integration and Preservation Solutions

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SY-03 Interconnectedness Of Data

The deluge of digital biodiversity datasets unleashed through institutional, national and global infrastructures brings up an inconvenient truth: internet-connected infrastructures are in a constant state of flux while preservation and integration of digital knowledge are often afterthoughts. Rather than taking digital amnesia for granted, we examine examples of durable and frugal digital data preservation and integration methods. Examples include tracking external datasets, creating verifiable data citations, cross-publishing and cross-linking datasets, reproducing data-integration processes, and distributing large data archives across poor, or nonexistent, internet connections. Topics include cryptographic hashes, Provenance Ontology, content-addressed storage, Unix philosophy, and offline first design as applied in projects like Preston (<https://preston.guoda.bio>) and Global Biotic Interactions (<https://globalbioticinteractions.org>). The examples are then related to best practices applied by proven knowledge-preservation experts: librarians and curators.

Keywords: biodiversity data, data preservation, data integration, biodiversity informatics
<https://osf.io/a2v8g/>

“Born digital,” Enabling a Field-to-Database Workflow for Herbaria

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SY-05 Managing And Digitizing Large Collections

Field researchers, such as those conducting floristic studies, accession thousands of records into natural history collections. The digitization of these records into online portals such as iDigbio and SERNEC is rapidly improving the accessibility and usability of these data. However, many of these digital records are incomplete transcriptions of the physical counterparts. For example, only 52% of Plantae records on iDigbio contain the date of collection. Yet, among those with date of collection there is a mean annual accession rate of over 170,000 records (2005 - 2015). The emergence of these portals imposes an additional responsibility for collection managers, the complete and accurate transcription of new accessions. “Born digital” records, those which have had their associated data initially gathered in digital formats circumvent this transcription process. Here we introduce the use of two open source programs, collNotes and collBook. Together, they enable a field-to-database workflow for herbaria. A mobile application, collNotes was developed for Android and iOS devices to gather Darwin Core formatted field notes. A desktop application, collBook was developed for Linux, OS X, and Windows to refine those field notes into portal ready Darwin Core files and specimen labels. Field note refinements include: reverse geocoding localities, taxonomic alignments, and creation of customizable labels which can optionally include catalog number barcodes. *Keywords:* biodiversity data, born digital, field work, herbarium labels, natural history collections <https://osf.io/qyzm3/>

Using the Virginia Tech Campus as a Laboratory for Assessing Dispersal Patterns and Biases in Land Plants

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SY-15 Broadening Participation of Students in Biodiversity Collections through a Network of Student Clubs

Plant colonization and succession has been well studied across many natural ecosystems; however, these processes are much less understood in anthropogenic ecosystems. We inventoried the flora of man-made structures on the Virginia Tech’s campus in Blacksburg, VA to determine the importance of dispersal strategy and source populations’ distance from colonization sites. The study system is highly dynamic, with brick, concrete, and Hokie Stone (a mix of dark and light gray limestone-dolomite blocks mined near Blacksburg) buildings dating to 1872. Complications that alter and reset the colonization process include constant turnover as new buildings are added and old ones are renovated and the ongoing maintenance and power washing of buildings. We sampled 121 buildings, recording species, coverage, and aspect of mosses and vascular plants on the buildings. We prepared specimens of each species for identification and as study vouchers. Herbarium specimens were inventoried to find source populations. It was expected that most species would be wind dispersed, primary colonizers, with most source populations in close proximity but some (like ferns and mosses with minute diaspores) potentially farther. We expected non-wind dispersed species to be rare and of low abundance. Identified specimens include 10 species of mosses, four species of ferns, and nine species of flowering plant. These species were then searched for diaspore type and dispersal ability. The nearest source population for each species was used to calculate colonization distance. An Analysis of Variance (ANOVA) test of variables including dispersal distance, percentage of buildings colonized,

aspect, and building age will determine biases in colonization success. These data will expand our understanding of anthropogenic ecosystems and provide empirical estimates of colonization ability of the Blue Ridge Mountain flora.

Keywords: Urban Ecology, Dispersal, Colonization
<https://osf.io/kq27s/>

Trapping High School Students with Fossils: Utilizing Science Outreach to Curate Natural Trap Cave Fossils and Inspire the Pursuit of STEM Careers.

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GS-02 General Session Poster Presentations

Despite rising emphasis on STEM education, public high-school students typically receive minimal exposure to historical biology or geology in school. Offering scientific outreach for high-school students is extremely important to help fill this gap. It generates much-needed excitement and interest in science, at a time when many students are exploring potential career paths, raises awareness about the necessity for natural history collections, can help address misconceptions, and potentially lead to greater support for science programs and research in the future.

Julie Meachen at Des Moines University (DMU) partnered with Kacia Cain at Des Moines Public School Central Campus to offer a semester-long, after school program in paleontology for 11-12th

grade students. The objective of this program was for the students to develop an understanding of the form and function of the vertebrate skeleton, preservational biases in the fossil record, and participate in each of the curatorial steps (cleaning, repair, identification, cataloging, and photographing) used for the long-term preservation of fossils. Students came to DMU, two hours a week to identify, curate, and analyze skeletal element representation of Quaternary megafauna recently recovered from Natural Trap Cave (NTC) in Wyoming. The students received high school and college credit for their participation.

The high school students had little to no background in paleontology, curation, or anatomy, so activities were designed around the fundamentals. Examples include reading NTC publications, drawing and identifying disarticulated skeletal elements of modern vertebrates, and discussions about taphonomic processes. Approximately 40 students over eight semesters (Fall, 2014 – Spring, 2018) took part in this outreach program and assisted in the curation of over 3000 fossils. Several of the students presented posters on the work they did during this outreach program at the numerous district and state science fairs held annually in Iowa and received accolades, including scholarship money. We think that similar, research-driven programs can be implemented at other institutions. Formal program recognition with course credit and sharing of suitable materials among a network of researchers will be key to their success.

This program was developed in conjunction with an NSF-funded research project (EAR/SGP # 1425059) and fossils were repositied in The University of Wyoming's Collection of Fossil Vertebrates.
<https://osf.io/sazqd/>

Rare and Interesting Plants Recorded in Poinsett County, Arkansas.

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GS-02 General Session Poster Presentations

Poinsett County, Arkansas, is located in the northeast part of the state and contains two major ecoregions: the Mississippi Alluvial Plain or "Delta" and Crowley's Ridge. Although 79% of the land in Poinsett is used for agriculture, it offers protected areas such as Singer Forest Natural Area and Lake Poinsett State Park, which provide a diversity of wetlands, riparian areas, and uplands. After three field seasons we collected 2,468 specimens and at least 604 species in 115 families. At least 230 species are county records and several are tracked by the Arkansas Natural Heritage Commission.
<https://osf.io/en4fm/>

Small Mammal Collections in the 21st Century: Impacts on Research Require Growing Genomic Resources and Establishing Data Availability

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SY-13 SCNet Symposium: No Collection Left Behind: Research Contributions of Small Collections

Since 1922, periodic surveys have been done to assess the status of mammal collections in the Western Hemisphere. The most recent survey

from 2017 reports approximately 4.6 million cataloged specimens from nearly 320 active collections in North America (Canada, United States, and Mexico) and 87% of these contain 25,000 or fewer cataloged specimens. Small collections are vital as they possess strength in their temporal depth and regional, geographic sampling. This allows small collections to become tools for addressing many research questions yet unknown. Information from the survey reveals that while it is becoming common practice to extract tissue samples, only about a third of North American collections currently maintain tissue collections. Moreover, the majority of these tissue collections have relatively small holdings, with 77% containing fewer than 10,000 vouchered specimens represented by tissues. Collecting tissue samples is fundamental to the expanded value of holistic specimen vouchers, but full specimen utility in research can be realized best through digitization and data sharing. Taking tissues and digitizing should now be standard operating procedure for all collections, but small collections in particular have much to gain by maintaining web-accessible records. An example with the Angelo State Natural History Collections (ASNHC) shows a doubling of requests received for tissue loans after digitization and availability on a searchable portal. Additionally, examination of the literature cited shows that ASNHC specimens were cited only 27 times between 2004-2008 but increased to 41 from 2014-2018. This presentation will discuss research value and utility of small collections using the ASNHC as a model. Digitization of mammal collections has been successful over the years, however the majority of undigitized specimens are predominately from small collections. Only 57% of all small collections are reported to be digitized, and worse, 76% of these remain unavailable to the public via a database aggregator portal. To maintain their role as

resource and repository in the genomic age of biological research, small collections must establish and grow tissue collections and ensure data accessibility.

Keywords: small collections, mammals, holistic voucher, tissue collections
<https://osf.io/egufm/>

Reconstructing Climate Change Responses of the Fern Genus *Cryptogramma* from the Last Glacial Maximum and Onwards

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SY-15 Broadening Participation of Students in Biodiversity Collections through a Network of Student Clubs

As the global climate changes and modelling techniques advance, ecological niche modelling (ENM) has emerged as a powerful and useful tool for conservation. The rock-loving fern genus *Cryptogramma* is an ideal candidate to study climate change impacts due to their preference for climate-sensitive habitats, such as sky islands and glacial margins. We focused on the three species in the Beringian *C. acrostichoides* complex: *C. acrostichoides*, *C. raddeana*, and their allotetraploid, *C. sitchensis*. Presence data were collected from herbarium collections, and ENM projections were created using WorldClim bioclimatic variables in Maxent. We generated ENMs predicting suitable habitat in the present day for each species, then projected our models to the last glacial maximum (LGM; 21kya) using paleo-climate data to analyze the ferns' response to rapid climate change after the Pleistocene. We also projected our models to future climate

scenarios (2070; rcp26, rcp45, rcp60, and rcp85), allowing us to identify suitable habitats for each species and focus conservation efforts. We found that *C. sitchensis* and *C. acrostichoides* most likely shared coastal refugia in southcentral Alaska and the Coastal Pacific Northwest (including Haida Gwaii) during the LGM, and that populations in the western contiguous USA will face critical conservation threats in the near future. We then independently assessed these results using molecular phylogeographic analyses. We constructed a chronogram using a six locus plastid data set (comprising 40 accessions from eight *Cryptogramma* species and six outgroup taxa), a relaxed-clock model, and two secondary constraints implemented in MrBayes. Most speciation events in crown group *Cryptogramma* occurred in the Pliocene and Pleistocene. We then reconstructed the phylogeographic history of *C. acrostichoides* and *C. sitchensis* during the Pleistocene and Holocene using the chronogram and accession range data in BayArea. These results also support the long-term presence of *C. acrostichoides* and *C. sitchensis* in southcentral Alaska, the Coastal Pacific Northwest, and unglaciated portions of the western contiguous USA. If these taxa have persisted long-term through dramatic climatic cycles in refugial locations, these locations may be key regions for surviving anthropogenic climate change.

Keywords: Ecological Niche Modelling, Last Glacial Maximum, Pleistocene
<https://osf.io/7adu2/>

Canadian Collection of Fungal Cultures: Contraction, Construction and Containment.

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GS-02 General Session Poster Presentations

Over the past 2 years the Canadian Collection of Fungal Cultures has been preparing for and carrying out a complete renovation of our facility. These renovations were due in small part to the aging facility but more importantly to meet regulatory biocontainment requirements for fungal organisms. Changes were designed and carried out to protect users and the environment from strains that are regulated in relation to human, animal and plant health. The completion of the renovation means that we are now operating in a facility that has been certified for Plant Pest Containment at level 2 (PPC2) and Containment Level 2 (CL2) for human and animal pathogens. Beyond questions of design and planning of the project one of the biggest challenges was housing the collection and continuing to work on it during the renovation. To address this challenge we needed to come up with creative ways to protect the collection and control access to it while in storage. We will present the challenges we encountered and lessons learned from the process. The collection has now returned to its newly renovated home with all the accessioned cultures in good condition and well contained. The facility is also modernised with the added bonus of increased capacity.

Keywords: containment, fungi, renovation
<https://osf.io/c8yka/>

Preservation Housing of Multi-Part Bird Specimen for Educational Use

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SY-10 Storage Techniques For Art, Science, And History Collections (STASH) Preventive Conservation And Storage: STASH Flash II

The Chicago Academy of Sciences / Peggy Notebaert Nature Museum has developed robust educational curricula incorporating real specimens to engage K-12 students and their teachers both within the museum and in schools across Chicago. These specimen-focused programs use all manner of prepared specimens, including mounted specimens, study skins, pinned insects, and dried organisms. Storage housing must serve to stabilize and preserve these specimens, while also facilitating use.

More complicated situations arise with specimens that are prepared in multiple pieces, which happen with specimens that have more bodily damage. In these cases, only the parts of the specimen that are salvageable are prepared, but this creates specimens that might be perceived as disjointed, especially to young audiences. This example demonstrates one approach for designing storage housing for a bird specimen that was prepared in multiple pieces that balances preservation and support of the specimen with educational use and display.
Keywords: storage, specimen, educational use
<https://osf.io/g3sdh/>

Unlocking Natural History at the Chicago Academy of Sciences

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SY-13 SCNet Symposium: No Collection Left Behind: Research Contributions of Small Collections

The Chicago Academy of Sciences is a smaller, regional natural history museum founded in 1857 with collections that date from the 1830s to the present. The collections are focused on the Midwest / Western Great Lakes region, particularly Illinois, and are interdisciplinary in nature.

One of our institutional priorities with the collections is to provide broad accessibility to the specimens and their data. While this is an important endeavor, it can be challenging with a small staff. Following collection inventories, specimen data is migrated into Arctos, a digital collections management system that also provides online accessibility. Specimen data is made available to an even wider audience through biodiversity data aggregators.

The Academy's collections provide a snapshot of the natural heritage before widespread urbanization and habitat change in the Midwest during the 20th century. Through a NSF Partner to an Existing Network grant, malacology and entomology specimen data have been migrated online and are being further enhanced with georeferencing, specimen photography, and connection to historical documents. Photographs taken during an ecological survey in northern Illinois during the early 1900s were discovered while digitizing glass plate negatives. These were traced to a publication about the survey that provided more detailed information for image metadata as well as for specimens collected during the survey.

Collections that have not yet been made available online still inform research projects. Botany specimen data, for instance, has not yet accessible online through Arctos or data aggregator. Numerous specimens were incorporated into a recent publication on local plants, "*Flora of the Chicago Region: A Floristic and Ecological Synthesis*", by Gerould Wilhelm.

Assessing the catalogued specimens from this collection and the current data available on Global Biodiversity Information Facility, when these data are made available online, the number of plants collected in Illinois prior to 1900 published through GBIF will increase by 19%, providing key baseline data for ecological research.

Keywords: online accessibility, regional collections, interdisciplinary

<https://osf.io/sx4zj/>

Export Compliance Issues in Natural History Collections

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GS-01 General Session Oral Presentations

Export compliance and proper permitting is important to the functions of natural history collections. Museum collections staff must be trained to ensure these protocols are followed correctly for specimen loan and acquisition. The Office of Foreign Assets Control (OFAC) of the US Department of the Treasury maintains and enforces comprehensive US economic sanctions (commonly called embargoes) against selected countries, certain individuals and/or entities. Violations of OFAC administered sanctions programs are subject to stringent criminal and/or civil penalties, and may include personal liability. Sanctions are focused on the country of origin of an object, sample, data, individual or information. To stay in compliance, it is essential to have taxonomic and locality information of incoming and outgoing specimens prior to shipment. In addition to OFAC, there are a

variety of US Fish and Wildlife laws which require the declaration of internationally shipped specimens (emphasizes the need to communicate the contents of packages before shipment). As active research institutions communication is key to making sure these transfers are done legally. Given the severity of penalties with both USFWS and OFAC to both institutions and individuals, training is needed for collections professionals and research staff to avoid violations. The practice of unsolicited packages should also be widely discouraged, as this makes museums vulnerable to legal responsibility if the package is opened without prior knowledge of the contents. With these changes in museum operations and better communication, ensuring the legality of specimen movements can be better accomplished.

Keywords: export compliance, permits, transactions
<https://osf.io/9bvyw/>

Byne Disease: From a Conservation Report to the Formulation of New Needs of Research

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SY-10 Storage Techniques For Art, Science, And History Collections (STASH) Preventive Conservation And Storage: STASH Flash II

Occurrence of crystalline efflorescence on calcareous specimens stored in polluted environments is commonly known as “Byne's disease” in reference to Bynes’s 1899 observations of damaged shell collections. It is related to the emission of acidic volatile organic compounds (VOCs) by storage or display materials. These VOCs, when absorbed by

porous calcareous substrates, may lead to the dissociation of calcium carbonate and rearrangement to calcium organic salts. This work was initiated by the conservation report of Alcide d’Orbigny’s (1802-1857) foraminiferal collection. D’Orbigny is a French naturalist, considered as the founder of Micropalaeontology. This collection, housed at the Museum national d’Histoire naturelle, Paris, includes approximately 800 preparations of specimens mounted on a microscope slide and placed on blue paper supports and in glass tubes hermetically sealed with cork caps. Some of these were affected and sometimes totally replaced by efflorescence. A short survey pointed out that other micropalaeontological collections were also concerned to a lesser extent by a similar decay. Micro-Raman analysis of degradation products showed a large occurrence and great variety of calcium organic salts, consistent with the phenomenon of “Byne's disease”. However, the detected mineralogical phases, among which formicaite, differ from those reported for the deterioration of Mollusca collections [1]. In the past decades, research has been dedicated to VOCs identification and pollutant emitting materials. Yet the mechanisms of crystalline formation that relies on adsorption, dissolution, and crystallization phenomena in a porous matrix, remain poorly understood. In particular, some of the detected organic salts seem to deliquesce, which has probably a great impact on deterioration when humidity fluctuates. These aspects definitely deserve further investigations. [1] Tennent & Baird, *Studies in Conservation*, 30(2):73-85
Keywords: Bynes, VOC, pollutant, calcareous, micropalaeontology, foraminifera
<https://osf.io/ysj6t/>

Cracking it Open: Addressing Mineral Instability within Museum Environments

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GS-01 General Session Oral Presentations

Historically, caring for mineral collections was widely perceived to be straightforward. However, approximately 10% of the 4,400 known mineral species are vulnerable to interactions with museum environments. Exposure to pollutants and inappropriate temperatures, relative humidity, and light can induce significant physical and chemical reactions which damage specimens and surrounding materials, and can lead to loss. Whilst some minerals - namely pyrite - have received considerable attention, research has been limited in scope and has done little to clarify guidance for the appropriate care and storage of geological materials. In a quest to begin to rectify insufficient guidelines, a research project has been developed to initiate evidence-based care of mineral collections by identifying the most susceptible minerals to average museum conditions, examining their reaction to varying conditions through accelerated aging, and analyzing their reaction products. This will provide results that aid in defining thresholds of deterioration-inducing agents, which will inform collection owners on how best to care for their specimens and mitigate future damage. These outcomes could also be applied beyond geological collections to other fields where minerals are commonly found as objects, pigments or metals.

Keywords: minerals, damage, deterioration, instability, conservation, research
<https://osf.io/xnt7f/>

Naturalis: Collection Management for the 21st Century

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SY-09 Collections Assessment For Natural History Collections: From Local To Global

In 2017 Naturalis Biodiversity Center realised that a large part of the current use of our collections required different needs from the traditional users. To ensure the continuous relevance of our collections, to be able to help both the modern and the traditional users we formulated a new Strategy. In this strategy some fundamental changes were initiated and we are now in the middle of a large scale transition process implementing these ideas. In this transition we are reorganising our organisation, update are procedures and working methods and develop new activities and services.

The Strategy program focuses on the collections as our unique asset. We manage one of the world largest natural history collections with a history going back more than 200 years. We focus on 4 areas of development: 1. improving curation and collection care, keeping our collections available and usable for generations to come; 2. developing information systems and coöperations that will create a global infrastructure for information; 3. we want our collections to inspire and inform, promoting their importance and beauty; 4. improving our organisation, facilities, expertise and working methods.

Keywords: collection management, strategy, change management
<https://osf.io/grcj2/>

Dreaming of a Museum: Significance of Addressing the “Wallacean Shortfall” and “Linnean Shortfall” in a Biodiversity Hotspot

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GS-01 General Session Oral Presentations

Many of the world’s described and undescribed species are concentrated in the global biodiversity hotspots. In these regions, the “Linnean Shortfall”, or the problem of undescribed lineages co-occurs with the “Wallacean Shortfall”, the lack of distribution data and both form a major impediment to our understanding of biogeographic and evolutionary history. One of the main challenges concerning the “Linnean Shortfall” is that of species delimitation, the outcomes of which have direct ramifications for studies in ecology, biogeography, evolutionary biology and conservation biology. In this work, I will illustrate, using a case study, how we have begun to unravel the species boundaries, diversification, and endemism of frogs, lizards and snakes in the Western Ghats Escarpment in Peninsular India. We used an extensive sampling regime and a hierarchical multi-criteria method to develop an approach to species delimitation, using frogs, lizards, and snakes. The hierarchical method included haplotype phylogeny, genetic distance, geography, ecology and morphology for delimiting lineages. Our results show a significant increase in the number of potential lineages in all the clades examined and brought to light the largest Vertebrate radiation in this region. The incorporation of geography in inference along with phylogenetic relationships played a significant role in uncovering a large number of missing sister lineages. These results

highlight the significance of addressing both the “Linnean Shortfall” as well as the “Wallacean Shortfall” to understand species boundaries. This approach incorporates biogeography for a nuanced understanding of lineage boundaries within clades. The sampling design also provides a robust framework to understand diversification and endemism in this hotspot. I will discuss some of the ongoing research in this direction. Finally, I will highlight, how we were also able to build a small collection facility.

Keywords: Western Ghats, Species boundaries, Evolutionary and Conservation biogeography, small collections

<https://osf.io/d3eua/>

Measuring Impact by Empowering Users to Illustrate the Effort They Put in Natural History Collections

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SY-06 Collecting Measures Of Success

Despite the world-wide importance of natural history collections, most are at risk because they are critically underfunded or undervalued. A significant contributing factor for this apparent neglect is the lack of a professional reward system that quantifies and illustrates the breadth and depth of expertise required to collect and identify specimens, maintain them, digitize their labels, mobilize the data, and enhance these data as errors and omissions are identified by stakeholders. If people throughout the full value-chain in natural history collections received professional credit for their efforts, ideally recognized by their administrators and funding bodies, they would prioritize traditionally unrewarded tasks and could convincingly self-advocate. Proper methods of attribution at both

the individual and institutional level are essential. However, metrics requested by institutional administrators are often divorced from employees' duties, their need to illustrate their expertise, or to advance their careers. Here we describe the necessary ingredients to effectively encode and share an individual's activities in natural history collections and for these to be aggregated within and across institutions, resulting in a more thorough illustration of reach that has never been fully appreciated. We also demonstrate a first proof-of-concept that underscores an appetite for this bottom-up, user-generated approach at gathering metrics of impact.

Keywords: metrics, attribution, credit
<https://osf.io/mn2be/>

Using the Swat Team Concept to Address Collections Backlogs

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GS-01 General Session Oral Presentations

One of the challenges in addressing a collections backlog is getting accurate taxonomic identifications for the specimens to be processed. The Swat Team approach works well when there is not in-house expertise to provide these identifications. This strategy has two components; finding an outside expert to identify the fossils, and then assembling a collections team to process the newly-identified specimens.

A long-standing backlog in the vertebrate paleontology collection at Field Museum involved thousands of vertebrate bones (mostly small mammals) collected from Quaternary owl pellet deposits in caves from the Nullarbor Plain in southern Australia. These specimens were

collected by Ernie Lundelius and Bill Turnbull in 1955 and 1964-1965. Ernie and Bill published a series of seven papers on specimens from Madura Cave based on specimens that were catalogued and integrated into the collection. But most of the specimens from the remaining caves were unprocessed. There were thousands of bones in bulk storage, taking up room, but not available for science.

We found our expert in Dr. Matthew McDowell, a post-doc at Flinders University in Adelaide, South Australia. In 2016 Matt spent six months at Field Museum and identified ~20,000 tooth-bearing elements, largely unprocessed, from rodents and small marsupials. We assembled a team of five paid summer interns to process these bones. Included in this intern group was a Field Museum Women in Science duo including an undergraduate and a high school student. Cathy Wiegand, the undergraduate, led the team of interns. Over the course of the summer of 2016 these interns created 11,098 new catalogue records. Processing included electronic cataloguing, physical numbering of the specimens, printing specimen labels, packaging specimens in gelcaps, vials, and acid-free cardboard specimen trays, arranging in drawers and printing drawer labels. One intern, Nicole Karpus, had experience taking photographs, and she took multiple high resolution photos of all the specimens. This aspect took another three months to finish.

These specimens document the pre-European small mammal fauna of the Nullarbor Plain, and are now available for studies including those by land managers looking to use “conservation paleobiology” to restore these small mammal communities to the extent possible.

This work was supported by an Endeavour Fellowship to Matthew McDowell, Bass Scholarship Funds to extend McDowell's stay,

and a Negaunee Grant to William Simpson.

Keywords: Swat Team Concept, Collections Backlogs, Conservation Paleobiology
<https://osf.io/bmz2u/>

Big Heads or Long Tails: How Smaller Fish Collections Contribute to Collections-Based Biodiversity Research

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SY-13 SCNet Symposium: No Collection Left Behind: Research Contributions of Small Collections

The biodiversity collections community is largely lacking in quantitative data that can be used to communicate importance to administrators, funding agencies and potential stakeholders. Data for what is contained within US collections are typically only kept by those that curate the collections. Even less data have been collected to explore collection use and researcher data preference and a lot of collection planning has been based on assumptions. Recently, some data from US fish collections have been collected from iDigBio in order to adequately explore collection holdings and give attribution to the collections that house the specimens. Additionally, a survey of over 430 fish biologists has been conducted to record data preferences. When used in concert, these data highlight some of the incredibly underappreciated and under supported data that small collections provide to the research community. From the data in iDigBio, over half of all fish records are contained in only 10 US collections, but the other half are housed in 28

other collections. Despite having fewer records, many of these smaller collections house unique resources like images, video, special preparations (e.g. cleared and stained specimens), tissues, and georeferenced localities in higher quantities than their much larger counterparts. These data are in high demand from fish biologists, but very few of these biologists know to look in these smaller collections to find it. Through looking closer at the data collections provide, it is possible to not only direct the future efforts of the larger collections with an eye towards what data biologists need, but also highlight the importance of maintaining many collections, even smaller ones.

Keywords: small collections, fish, informatics, sustainability, research
<https://osf.io/s3har/>

Collections Make Connections at the Iziko South African Museum

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GS-01 General Session Oral Presentations

Iziko Museums of South Africa is a National Heritage Institute, established in 1999 as a flagship that now governs eleven individual museums in Cape Town. Founded in 1825, the Iziko South African Museum (iSAM) is the oldest and largest of the group. It houses important palaeontology, archaeology and African zoology collections. The various natural

history collections have over 4 million objects of which only about 700,000 are entered into a Specify database. The Museum supports onsite research programs with 10 full-time curators and 12 collections managers. For the last seven years iSAM has embarked on an extensive upgrade of collections, research facilities and public outreach spaces. New interactive displays will enhance the visitor experience and showcase behind-the-scenes research and collections activities. Within the natural history collections at iSAM, the internationally-known Karoo Palaeontology Collection preserves an exceptional record of: 1) early mammal evolution, 2) the Permian-Triassic mass extinction, and 3) one of the most complete terrestrial sequences on Earth ranging in age from the Late Carboniferous to Middle Jurassic. This Collection houses over 10,000 fossil specimens of vertebrates, plants and traces and attracts on average 20 local and international visiting researchers per year. In the last thirty years the growth of the collection has increased significantly and today there are over 458 type specimens in the Collection of which 278 are holotypes. The Museum's fossil preparation lab is staffed by five dedicated technicians who continue to hone their skills with fossils of all sizes and types of preservation. The preparators are integral to research-driven field work and are responsible for finding many of the most important specimens on these trips. To engage the public, preparators also staff a fossil demonstration lab in the exhibition space that has been a popular feature at the Museum for over 15 years.

Keywords: South Africa, Palaeontology, Karoo, Therapsids, Cape Town
<https://osf.io/ym3ke/>

Non-Destructive Destructive Sampling: The Uses and Limitations of Computed

Tomography (CT) for Traditionally Destructive Investigations

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SY-14 Best Practices in Destructive Sampling: Methods for Limiting Specimen Information Loss While Maximizing Research Potential

Advances in computed tomography (CT) and micro-CT technology in the last several decades has been a boon to natural history researchers across a wide range of disciplines. The ability to virtually slice open natural history specimens with CT scanning allows for inspection and quantification of small internal structures without any damage to the specimen. CT scanning is an especially good alternative to destructive sampling in the case of especially rare or fragile specimens (e.g., fossils encased in hard matrix, mummified remains), and when relevant data are easier to obtain when the specimen is whole (e.g., metrics on soft tissue structures in the vertebrate body). Although CT scanning can reduce the pressure on natural history collections to allow for destructive sampling of specimens, it works best for a specific set of problems and cannot fully replace destructive sampling for all specimen-based questions. Here I discuss the how my current research on the trabecular bone morphology of mammalian vertebrae benefits from micro-CT data, and reduces the need for destructive sampling to test functional morphology hypotheses; I further note how CT data can be used in lieu of physical specimens in a variety of morphological and functional investigations. I also expand on current limitations of CT data for particular specimen-based work, and places where it cannot replicate data obtained through accepted destructive methods.

Keywords: computed tomography (CT), micro-CT, destructive sampling, Non-destructive destructive

sampling
<https://osf.io/k6v57/>

The Role of Natural History Collection Databases and Historic DNA in Conservation from Texas to the United Kingdom

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GS-01 General Session Oral Presentations

Species become imperiled for a variety of reasons, including, but not limited to: habitat loss and fragmentation, exploitation, human population growth, and climate change. In addition to these threats, limited funding and lack of data on wild populations can result in misinformed management, limiting scientific research, and ultimately hindering recovery goals. As a result, scientists have had to be creative when studying imperiled species. Here we present two projects that creatively use natural history collections to provide invaluable data for conservation research and management. In Texas, the Texas Parks and Wildlife Department (TPWD) is responsible for designating and managing the state's list of Threatened and Endangered species and the Species of Greatest Conservation Need list. To quantitatively evaluate the status of these imperiled species, TPWD uses abundance and trend data combined with specific threat vulnerability using the NatureServe®

Conservation Rank Calculator. Since the calculator relies on historic data, TPWD relies on publicly available museum databases to fill gaps in scientific data sets. Similarly, scientists studying Critically Endangered and Endangered sawfishes (Family Pristidae) rely on museum specimens for historic DNA samples. Historic DNA can be used to determine baseline information about historic populations such as abundance and levels of genetic diversity. Because natural history museums in the United Kingdom contain large collections of sawfish specimens, spanning three centuries that are geographically diverse, scientists have sampled historic sawfish DNA from these collections. Without these resources from natural history museums, it would be impossible for scientists to answer questions fundamental to the recovery of these imperiled sawfishes and difficult for natural resource managers at TPWD to identify and prioritize essential actions for imperiled species recovery. Thus, for both projects, natural history collections have played a direct role in conservation research and management of threatened and endangered species, making alliances among individual scientists, state agencies, and museums critical for scientific progress.

Keywords: imperiled species, conservation research and management, sawfish
<https://osf.io/vbhww8/>

Natural History Collections as Interdisciplinary Crossroads

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GS-01 General Session Oral Presentations

Natural history collections offer unique opportunities for merging scientific

understanding with cultural awareness. Emily Smith will explore how the development of the 2018 Randolph College exhibition, “Epochs of Nature: [R]evolutions in Climate, Geology, Species, Culture,” enabled collaborating faculty and students to place natural history specimens in context with literary and historical works, art, and artifacts from five Randolph College collections and two off-campus archives. Multi-disciplinary approaches to the presentation of natural history topics make scientific collections relevant and accessible to an array of individuals whose interests are humanities-focused, expanding the possibilities for creative dialogue surrounding important topics such as climate change, biodiversity conservation, and environmental protections in the much-debated “Anthropocene.”

Keywords: interdisciplinary, multidisciplinary, humanities, culture, Anthropocene, exhibitions
<https://osf.io/cwzrn/>

Do Storage Temperatures Affect DNA Quality of Samples in Genetic Resource Collections?

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GS-01 General Session Oral Presentations

Frozen tissue samples housed in natural history collections have many uses in the fields of biology, ecology, virology, taxonomy, and evolution. The recent increase in genomic level sequencing has generated an ever-increasing interest in using properly archived tissue samples. Therefore, it is imperative that frozen

tissue collections are preserved and maintained in perpetuity. In order to accomplish this, tissue samples should be maintained in an environment that is sufficiently cold as to prevent damage to the tissue and DNA. Historically, -20°C and -80°C storage conditions were used for most frozen tissue collections. Recently, many institutions are starting to implement the use of liquid nitrogen freezing systems, which enable storage at temperatures as low as -196°C. To examine the affects of traditional storage conditions of frozen tissue collections (-80°C), tissue samples were obtained from the Genetic Resource Collection at the Natural Science Research Laboratory of the Museum of Texas Tech University. To control influence of body size variation and preparator experience, samples from Cricetid rodents prepped by a single individual were obtained at ten-year intervals ranging from 1986 to 2016. DNA was extracted using robotics for consistency, and the relative proportion of DNA of different molecular weights was assessed using a Fragment Analyzer. Molecular weight of samples were analyzed as a function of time and temperature. There was a significant difference in DNA quality between tissues from 1986 when compared with the other three time periods. Additionally, there was a significant difference in DNA quality between liver and muscle tissues.

Keywords: Liquid Nitrogen Freezers, DNA Degradation, Genetics, Mechanical Freezers
<https://osf.io/j53qg/>

Building a Student and Volunteer Network for Notes from Nature Herbarium Transcription Success in Arkansas

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GS-02 General Session Poster Presentations

Arkansas herbaria are developing a statewide network of students and volunteers to support specimen transcription through the Notes from Nature (NfN) platform. Since 2014, we have imaged >165,000 herbarium specimens in Arkansas, mostly with skeletal data (family, species, state, and county). In July 2016, we created our first NfN expedition in our Plants of Arkansas: Discovery and Dissemination group. With 20 expeditions launched, we have added ~25,000 records to SERNEC through NfN transcriptions, and each specimen was transcribed three times for consensus for a total of >70,000 transcriptions. We completed eight expeditions as part of a dendrology class assignment, and more plant taxonomy instructors are incorporating NfN into class syllabi statewide. For the past three years, we also supported an annual transcription blitz at A-State, associated with WeDigBio, with 50-100 student participants who transcribe 1000-2000 images in a single day. Our greatest short-term progress has been completed by 14 volunteers, many who are master naturalists, supporting focused, county-level floristics projects for the Arkansas Natural Heritage Commission. For building a network to maintain NfN transcription progress, multiple groups should be involved, including classroom assignments, Master Naturalists, Master Gardeners, natural heritage volunteers, and reaching out to native plant

societies, national park and forest service employees to generate new sources for volunteer activity. Through expansion of the NfN community with local support for regional projects, we can effectively transcribe herbarium data for research, and volunteers and students can be involved from the comfort of their own homes.

Keywords: Notes from Nature, transcription, volunteers, students
<https://osf.io/4e963/>

(Re)blazing Stars in the Mississippi Alluvial Plain of Arkansas

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SS-01 Specimen Spotlight

The hairy blazing-star (*Liatris hirsuta* Rydb.) is relatively common throughout its range in America's heartland from Kansas to Louisiana, but it had been extirpated from the eastern edge of its range in the Grand Prairie ecosystem of the Mississippi Alluvial Plain ecoregion. The last known occurrence, recorded in 1955, was from Arkansas County, AR, with the nearest previous record in 1932. In June and September 2018, I collected a putative *L. hirsuta* from post-oak flatwoods on a private property adjacent to Pine City Natural Area (PCNA), east of the Grand Prairie. This specimen closely resembles *L. hirsuta* but is also similar to a potentially undescribed species known from the blackland prairies in southwestern Arkansas. Is the *Liatris* sp. from PCNA a rediscovered species believed to be locally extirpated or an undescribed species? Either way, the outcome is exciting.

Keywords: range record, putative new species, rediscovery

How Much Research Could a Bat Bug Bolster, if a Bat Bug Could Bolster Research?

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SS-01 Specimen Spotlight

The family Cimicidae includes species of bed bugs, swallow bugs and bat bugs.

The host specific relationship between the bat and its bug is what make this species worth investigating. As a historically understudied group, Arkansas State University is using its Center for Biodiversity to build a collection of bat bugs for future investigative research.

This side project began out of another research project studying a maternity colony of Rafinesque's big-eared bats (*Corynorhinus rafinesquii*). In the summer of 2018, fifty-five bats were collected in Jackson County, AR with most bats from the maternity colony having bat bugs attached, raising questions about their effect on the bat's overall health. So, the collection began in effort to elucidate host species interactions and to address general ecological questions surrounding the bat bug. By careful collection and curation, the bat bug specimens will be available for research and be preserved for limitless possibilities for studies on parasite host interactions as well as being properly prepare for future outreach events for Arkansas State University.

Keywords: Bat, Bug, Collections

<https://osf.io/ef256/>

Connections with Collections**Ben N. Spitz**

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SY-15 Broadening Participation of Students in Biodiversity Collections through a Network of Student Clubs

As a student at Missouri State University I helped with an enormous task of cleaning specimen drawers and attempting to digitize our collection as well as even becoming vice president. Near the end of my undergraduate career at MSU, I was given the opportunity to go to a behind the scenes trip to the Zoo and Botanical Gardens with another curation club. There I met like minded individuals from Arkansas State University who told me about their great work and research in their Natural History Collection. Little did I know that Arkansas State University would be the place I sought my higher education and pursue my passion of curation.

<https://osf.io/m3ad6/>

Catching up on Vertebrate Paleontology Loans: Groundtruthing for Success**Adrienne M. Stroup**

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GS-01 General Session Oral Presentations

Groundtruthing can be described as collecting accurate, observable data on location to gain insight to solving a problem. This process was used throughout the Field Museum's vast vertebrate paleontological (VP) collections to determine the true status of its open loans. The Field Museum's VP collection contains over 100,000 catalogued specimens, and though this is smaller than many of the museum's collections it is arguably amongst the most active in terms of research, exhibits, and loans. In 2015, when we began the groundtruthing project, the VP collections had over 500 loans open to research scientists and exhibiting institutions. A systematic check of each invoice against the physical collection has yielded a concise record

of all specimens currently on loan. By rectifying outdated records, this procedure has brought the number of open loans down to less than 370. Our records show that 215 vertebrate paleontologists from 15 countries around the world are currently borrowing fossils from our collection. Specimens borrowed are typically the most scientifically valuable in terms of preservation, rarity and provenance data, many of which are holotypes.

The groundtruthing project faced challenges ranging from vague or incomplete historical paper records to loans of uncatalogued specimens. Organization, attention to detail, and perseverance were crucial to achieving the goals of this project. Moving forward, we are designing our “dunning” procedure whereby we ask for our overdue loans back to ensure these specimens are available to other researchers and future exhibitions. The proposed presentation will discuss the challenges and successes of this project and what lies ahead for the Field Museum’s geologic collections loan program.

Keywords: loans, vertebrate paleontology, groundtruthing, project, dunning,
<https://osf.io/dq7zt/>

Shape Diversity and Evolution of Catfishes (Order Siluriformes)

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GS-02 General Session Poster Presentations

Catfishes (Order Siluriformes) number over 3,000 species and comprise roughly 5% of all vertebrate species. The study of the evolution of their morphological diversity has focused primarily on comparative morphology of osteology and myology. By contrast, there has been little attention to the evolution of their shape diversity. Defenses against predation may

influence catfish shape evolution. Catfishes vary in the presence of defenses against predation, including pectoral- and dorsal-fin spines, and venom. Earlier research has demonstrated that catfishes with longer pectoral-fin spines have wider bodies and fishes with dorsal-fin spines have deeper bodies, suggesting catfishes and fishes with spines maximize their lateral and dorsoventral dimensions to escape predation. This correlation suggests that predation pressure and the evolution of morphological defenses against predation influenced the shape evolution of catfishes. Pectoral-fin spines likely originated once within catfishes and were lost multiple times, while the dorsal-fin spine may be more labile, with more origins and losses. The independent losses of fin spines provide natural replicates to test the influence of the absence of fin spines on morphological diversification. We explore the relationship between patterns of body shape evolution and fin spine evolution across catfishes using 3-dimensional landmark-based geometric morphometrics of preserved specimens of representative catfishes.

Keywords: fish, diversification, shape
<https://osf.io/2p6yj/>

Digitization - The Backbone of Our Strategy to Increase Accessibility to Vertebrate Collections

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GS-02 General Session Poster Presentations

As museum collections continue to grow, a major challenge is disseminating the information within them. Digitization greatly increases a collection’s accessibility, thereby maximizing its use, and creates opportunities to generate new knowledge. The Vertebrate Zoology Collections

of the Canadian Museum of Nature (CMNVZC) holds ca. 1,250,000 catalogued specimens. They are mainly but not exclusively comprised of Canadian species, and provide a full taxonomic range and extensive temporal and geographical coverage. Very early digitization initiatives started in 1972 to facilitate the organization of the CMNVZC data. After continued efforts dating back to 1980, virtually 100% of the core data of CMNVZC records are now digitized and can be retrieved online via biodiversity data portals (e.g., GBIF, and VertNet). The aim of our strategy is to increase accessibility and usability of specimens and associated data to support research, collections, education, and outreach activities. Efforts are now focused on secondary digitization, which consists of optimizing collection usability by adding value to existing records. This is achieved by adding georeferencing data, imaging collection-related documents, imaging specimens (2D and 3D), and making all of this information available online. Our vision is to go entirely digital and make our collections available for remote dynamic use. However, imaging vertebrate specimens represents a major challenge given that they come in all shapes and sizes and are preserved in a variety of ways. With limited resources and space for data storage, prioritization of selected specimens is required. Here, we show how careful planning can be used to successfully digitize a vertebrate collection.

Keywords: Digitization, Vertebrates, Canadian Museum of Nature
<https://osf.io/ej7k/>

A Proposed Metadata Standard for Recording and Sharing Attribution Information

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SY-06 Collecting Measures Of Success

Research collections are an important tool for understanding the Earth, its systems, and human interaction. Despite the importance of collections, many are not maintained or curated as thoroughly as we would like. Part of the reason for this is the lack of professional reward for collection, curation, or maintenance. To address this gap in attribution metadata, the Research Data Alliance (RDA) and the Biodiversity Information Standards (TDWG) organization co-endorsed a Working Group to create recommendations for the representation of attribution metadata. After 18 months, this Working Group recommended a very simple data exchange standard to link people, the curatorial actions they perform, and the digital or physical objects they are curating. These recommendations are discussed in the context of community-developed use cases. Future work includes (1) adapting these recommendations to the specific needs of the natural history collections community, which could include development of a Darwin Core extension, (2) recommendations on how to best record agents, activities, and entities in collections management platforms such that these data can be shared, and (3) recommendations and possible solutions to help accelerate the process of reconciling people and their activities in legacy data.

Keywords: attribution, metadata, collections, specimen, standards
<https://osf.io/jwrq2/>

Extending U.S. Biodiversity Collections to Address National Challenges

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GS-01 General Session Oral Presentations

A workshop held 30 October - 1 November 2018 at Oak Spring Garden in Upperville, VA under the leadership of the Biodiversity Collections Network (BCoN) addressed the future deployment of data held in U.S. biodiversity collections for research, policy and education. In their discussions, participants drew heavily on recent literature as well as surveys, meetings and workshops held over the past year with the stakeholder community of collections professionals, researchers, and educators. Arising from these deliberations is a consensus to focus future biodiversity documentation on building a network of extended specimens that represent the depth and breadth of biodiversity held in U.S. collections institutions. The extended specimen will consist of the physical voucher and any preparations (e.g. tissue samples); digitized representations such as occurrence records and images; derivative products such as gene sequences or metagenomes; and taxon- or locality-specific data such as observations, phylogenies or species distributions. We will extend existing specimens w by data linkage through unique identifiers, taxon name and location. New collections, needed now more than ever to inform solutions to societal problems, should be “born-extended”, i.e., accessioned with a full suite of supplemental data. Collectively, these extended specimens will form a network of linked data to enable exploration across taxonomic, temporal and spatial scales. Such exploration will help us understand the rules that govern how organisms grow, diversify and interact with one another, and how environmental change and human activities may

affect those rules. As a resource for formal and informal education (including citizen science), the extended specimen network will afford scalable learning opportunities for K-Life in data literacy as well as biological science and the humanities. To create this resource will require continued specimen digitization, new collections, standardization of existing digital data to facilitate discovery, and implementation of a robust specimen identifier tracking system. It will also require new approaches to data sharing and collaboration, partnerships with national and international data providers, computer and data scientists and educators. This initiative requires episodic funding for collection of new specimens as well as for digitization and curation of existing resources. It requires long term funding for a central organizing unit with responsibility for community coordination, education, mobilization, and maintenance of the central data repository and the network infrastructure. Representatives of the central organizing unit, collections institutions, and professional societies should oversee the implementation of the agenda.

Keywords: Biodiversity collections, digitization, extended specimens, extended specimen network
<https://osf.io/xqjrg/>

Natural History Collections in Liberal Arts Education

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SY-13 SCNet Symposium: No Collection Left Behind: Research Contributions of Small Collections

Wesleyan University (Middletown, CT) was seeking to put natural sciences on an equal footing with classics in the Methodist tradition, and in 1871 opened a museum with archaeological, ethnographic, biological (taxidermy, skeletons, alcohol), geological and paleontological collections. The latter include fossils from famous lagerstätten (e.g., Burgess Shale, Solnhofen, Green River, Florissant), the Jurassic Connecticut River Valley, and hundreds of Ward's casts. With the rise in importance of laboratory sciences in the 1900s, interest in the museum declined and it closed in 1957. Specimens were sent to other museums, loaned to schools, and stored in various basements and attics across campus. By the 1970s, collections had been severely vandalized and many specimens were lost, but hundreds of thousands of remaining specimens were secured but not documented, and largely forgotten. In 2017, we began to bring specimens out of storage to digitize them, locate accession information, curate for exhibition, and use them in object-based learning. One of our primary challenges is the limited museum space, so we are building temporary and mobile exhibits to move about campus. Our museum was grounded in 'cabinets of curiosities', and we use this form in some of our moveable exhibits to reach a wide audience, reaching out to the non-STEM community on campus. The unique, irreplaceable specimens are valuable and significant for education about the natural world: 19th century collections can be used to compare past and present distributions of organisms, and predict biotic response to changing future climate, as well as obtain information about habitats in the 1800s and pollution during the industrial revolution through stable isotope and trace elements analysis. We integrate specimens in teaching and outreach, including a popular program using the osteology collection for elementary school students and parents. We employ social media as versatile

platforms to engage non-STEM audiences in the natural sciences, including a facebook page, twitter feed, and interactive displays, museum blogs and story maps (<https://arcg.is/0jyWjC>) using QR Codes on smart devices. We aim to make the historical collections a focus of integrated student investigation, combining biology, paleontology, history of science, archaeology and the arts.

Keywords: Collections, Paleontology, Education
<https://osf.io/eyagc/>

Maintenance, Migration, and Adaptation: Developing Best Practices for the Curation of Natural History Collections Databases

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GS-01 General Session Oral Presentations

Though natural history collections are meant to last for generations, the specimens, records, and documents they contain require considerable care to last more than a few months or years. Digital representations of these collections – including collections databases -- are particularly fragile and must consequently be upgraded and migrated frequently to avoid bit rot and obsolescence. While there are a number of best practices, guidelines and metadata standards aimed to support the curation and management of individual data objects, there are precious few to support collections staff in the complex tasks (e.g. data modeling, schema matching, data transformation, provenance capture, etc) entailed in migrating an entire database. Best practices are sorely needed for the curation, maintenance and migration of this essential collection infrastructure.

In this talk, I present early findings from an IMLS-funded project studying the maintenance,

evolution and migration of research databases housed in natural history museums. I interviewed collections staff at 10 institutions about their experiences migrating collections databases. I also examined their legacy and current database structures to better understand how they were adapted and changed over time. I find that database migration is an on-going – rather than occasional – process for many collection managers, and that they creatively innovate on many existing technologies in their migration work. I present a set of common adaptations and “migration patterns” in the practices of these collection managers and outline the strategies they use when facing collection-level data migration. I also present some preliminary best practices that might help other collections staff in this challenging work. I conclude by outlining future research directions for the maintenance and migration of digital collections, and discuss how the fields of Information Science and Natural History might better coordinate their efforts toward data(base) curation.

Keywords: databases, collections management, data curation, database migration

<https://osf.io/y6xfv/>

Bringing Microfossil Specimens into the Light: Using Semi-Automated Digitization Techniques to Improve Collection Accessibility

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SY-05 Managing And Digitizing Large Collections

Natural history collections are often considered remote and inaccessible without special permission from curators. Digitization of these collections can make them much more accessible to researchers, educators, and general enthusiasts

alike, thereby removing the stigma of a lonely specimen on a dusty shelf in the back room of a museum that will never again see the light of day. We are in the process of digitizing the microfossils of the Indiana University Paleontology collection using the GIGAmacro Magnify2 Robotic Imaging System. This suite of software and hardware allows us to automate photography and post-production of high resolution images, thereby severely reducing the amount of time and labor needed to serve the data. Our hardware includes a Canon T6i 24 megapixel DSLR, a Canon MPE 65mm 1X to 5X lens, and a Canon MT26EX Dual Flash, all mounted on a lead system made with high performance precision IGUS Drylin anodized aluminum. The camera and its mount move over the tray of microfossil slides using bearings and rails. The software includes the GIGAmacro Capture Software (photography), GIGAmacro Viewer Software (display and annotation), Zerene Stacker (focus stacking), and Autopano GIGA (stitching). All of the metadata is kept in association with the images, uploaded to Notes from Nature, transcribed by community scientists, then everything is stored in the image archive, Imago. In ~460 hours we have photographed ~10,500 slides and have completed ~65% of our microfossil collection. Using the GIGAmacro system we are able update and store collection information in a more secure and longer lasting digital form. The advantages of this system are numerable and highly recommended for museums who are looking to bring their collections out of the shadows and back into the light.

Keywords: microfossils, GIGAmacro, paleontology, digitization, automation, semi-automation
<https://osf.io/qukma/>

Fungarium Feasting: Which pests are Eating Mycological Collections?

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GS-02 General Session Poster Presentations

It has long been accepted that the major pests in herbaria are cigarette beetles (*Lasioderma serricornis*) and drugstore beetles (*Stegobium paniceum*). Historically, many herbaria have ignored dermestids and other protein-eating pests as collections problems and treated them as more of a general nuisance. However, this may not be the case for fungal collections, which are full of proteins and chitin. Anecdotally, the authors have seen frass and cast skin evidence to suggest that a wider variety of pests are eating fungarium specimens. In this poster, we outline our research proposal to identify which pests may be critical to monitor for in fungarium collections and ask for feedback prior to conducting the study.

Keywords: herbarium, fungarium, IPM, pests
<https://osf.io/m4yrx/>

Large Institutions' Post-TCN Struggles with Data Maintenance

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SY-05 Managing And Digitizing Large Collections

Large herbaria, such as the William and Lynda Steere Herbarium and the Harvard University Herbaria, have been involved in several pioneering cryptogamic Thematic Collection Network (TCN) projects. Each project's data sits in a separate Symbiota portal, which the public and research community actively consults and reviews. However, the amount of work needed to maintain data accuracy in both local collections management systems and the Symbiota portals quickly spirals out of control. The portals lack consistent ways for institutions to apply massive changes to data as specimens are updated locally. Conversely, there is no reliable way for institutions to ingest data that has been directly edited in the portals through crowdsourcing. Although the TCNs and their associated material support have come to an end, institutions are responsible for this upkeep as well as adding all relevant newly received material into the portals. When there are no longer staff members dedicated solely to TCN projects, data maintenance tasks often lose priority, resulting in data existing in different stages of accuracy locally and on portals. This is a disservice to researchers who rely on this publicly available data.

Keywords: herbarium, digitizing, TCN, data
<https://osf.io/k73rp/>

All Grasses Great and Small: Reorganizing and Rehousing the Poaceae Collection at the US National Herbarium

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GS-01 General Session Oral Presentations

In 2017, the US National Herbarium started a project to reorganize and rehouse the historically

significant Poaceae, or grass family collection. This collection, one of our largest, consists of approximately half a million specimens. Our collection of Poaceae contains critical food crops, such as corn, rice, and wheat and covers wild and cultivated vouchers collected over the past two centuries. Researchers actively use our collection.

Unfortunately, the organizational scheme had not been actively updated. To add a further complication, in the 1950s, it was decided by the staff of the Division of Grasses to reorganize the collection alphabetically. This is different from the rest of the herbarium's taxonomic order. The size of this collection makes it difficult to keep this alphabetical system up to date. For example, in 1978, when the genus *Schzachyrium* was split from *Andropogon*, two hundred herbarium cases were shifted. Currently we do not have the staff to conduct these types of shifts; a new scheme was needed. We decided to change the collection back to a taxonomic order.

The second part of the project was to rehouse the collection. Color coordinated folders, unique to Poaceae collection, were used to subdivide each genus into geographical regions that did not match the rest of the herbarium. These folders were nonarchival, and with age showed fading such as blue fading into gray and yellow into beige. This caused added confusion since all four of these colors were used to represent different regions so that folders were often misfiled. Finally, we tested the folders and discovered they were acidic (pH of 4.65). To correct these issues and preserve this collection, we were able to secure a Collection Care and Preservation Fund Grant, an internal grant provided by the Smithsonian Institution National Collection Program. Using this funding we were able to hire four contractors. One of these contractors is a Poaceae expert while the other three contractors

are experience museum professionals to help with the day to day tasks.

First step was to create space needed for both our contractors and for the collection. We moved the contents of the gymnosperm collection cases that came before the Poaceae collection to a different floor giving us space. Next, a protocol was developed where the expert would work ahead of the three contractors, moving the folders from their alphabetical location to their proper place in the taxonomic sequence. He would also write a note indicating the new genus name onto the old folders. Then these old folders were replaced by new folders stamped with the updated name. It was quickly discovered that many of the specimens were not annotated and the process changed to include annotation of the specimens. When the annotation process began to slow the workflow, the protocols were altered again.

There are many lessons learned from this process. A taxonomic expert in the family is critical to oversee the process. Second, it is easier to reorganize a collection when there is space to shift specimens. The moving our gymnosperm collection gave us the room to start the reorganization process. We also needed work space for all our contractors. These spaces included both mobile in the form of seven movable carts and stationary in the form of office space. It is also important to be flexible, since the original plan had to be altered as unexpected issues appeared. Overall this process has helped to protect our specimens as well as organizing the Poaceae so that researchers can use the collection efficiently.

Keywords: Herbaria, Collection Management, Collection Moves, Collection Reorganization
<https://osf.io/zgd9n/>

The Australian National Insect Collection: An Ever-Growing International Hub for Entomological Science

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GS-01 General Session Oral Presentations

The Australian National Insect Collection (ANIC) is one of the National Research Collections in the custody of the CSIRO (Commonwealth Scientific and Industrial Research Organisation) in Canberra.

ANIC is a relatively young collection, nonetheless its relevance in the entomological international research scenario is undeniable. Since its inception in 1926 in fact the collection has not only grown in size steadily and significantly, it has also grown in its reputation and respectability amongst entomological scientists worldwide. The Australian entomological fauna is proving to be of critical importance in unravelling the evolutionary biology and high-level systematics of many different groups. Therefore the use of our collection as a reference for morphological work and molecular analyses is becoming increasingly important. In fact, ANIC is the world's largest collection of Australian insects and related groups, housing over 12 million specimens, including more than 20,000 primary types. As such, ANIC is a critical resource for the work of entomologists all over the world working not only in systematics, but also biosecurity, biogeography and more. The collection is visited on average by over 100 scientists every year and we estimate we have over 200,000 specimens out on loan at any given time.

Amongst our facilities are: a molecular genetics lab equipped with state-of-the-art and high-

throughput devices, used for deep-level phylogenomics and collection genomics of even our oldest specimens; an imaging lab for scientific outputs, which includes an eSEM for observation and imaging of fine morphological details even on type specimens and a high-resolution imaging station equipped for macro and micro photography; a digitisation hub, where collection specimens and labels are imaged and the data then incorporated into our growing database.

We estimate ANIC increases its size by more than 100,000 specimens each year and this includes pinned, slide-mounted and ethanol-preserved specimens, as well as the new and fast-expanding frozen collections for molecular research. ANIC is focused on making this healthy collection growth sustainable in our current accommodation, aiming at the highest standards in collection management to maintain, if not increase, our relevance in entomological science into the future.

Keywords: Entomology, Australia, collection, research

<https://osf.io/k3fcy/>

From Butterflies to Ichthyosaurs the Importance of the Nevada State Museum, Las Vegas Natural History Collections

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GS-01 General Session Oral Presentations

Managing a small museums natural history collection has been a challenging experience. Because the majority of the collections are not cataloged, let alone accessioned, it is challenging to know what specimens or artifacts are significant to interpreting Nevada's natural history. The George T. Austin herbarium of

Lepidoptera host plants along with butterfly specimens collected in association with the plants has been one of the most interesting and significant finds so far. In addition, an opportunity to have our fossil ichthyosaur type specimens (*Shonisaurus popularis*) inventoried, photographed, rehoused, and condition assessed was presented in early 2018. Graduate student Paige E. dePolo volunteered to take on this project and significantly aided in our ability to manage these giant ichthyosaur specimens. In the process of inventorying the fossils, evidence for dental development and the sex of Specimen A was determined adding to the research of Nevada's ichthyosaurs. An update of our progress in processing these collections will be presented along with exciting future research projects.

Keywords: Nevada, ichthyosaur, Lepidoptera, herbarium

<https://osf.io/px8q2/>

Rediscovering Iris the Ichthyosaur: The *Shonisaurus popularis* Type Specimen at the Nevada State Museum, Las Vegas

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SS-01 Specimen Spotlight

The type specimen of *Shonisaurus popularis*, Iris the Ichthyosaur (also known as Specimen A) is a popular attraction along the way to understanding new specimens of these iconic animals. *S. popularis* lived along the coastline of Nevada during the late Triassic. At the time of its discovery in the 1950s, *S. popularis* was one of the largest ichthyosaurs known, but in the

decades since other gigantic ichthyosaurs have been found in Canada, China, and England. In order to contextualize these new discoveries, paleontologists need to access the type specimens of *Shonisaurus popularis* for comparison. Thus, researchers from around the world come to see these giant fossil remains unique to Nevada.

Prior to the summer of 2018, visiting researchers had to brave a neglected collection with deteriorating boxes full of Styrofoam peanuts, leaves, wasp nests, and ancient plastic wrap with no systematic numbering system or accession records available for guidance. Nevada's ichthyosaur fossils were brought to the Nevada State Museum, Las Vegas in 1998 after spending almost 20 years at the University of Nevada, Las Vegas and about a half a decade prior languishing at the Foresta Institute in Northern Nevada. Since their excavation, there has never been a comprehensive inventory of the ichthyosaur bones, an estimate of the number of individuals, or a conservation assessment. The museum took on this challenge in early 2018. Each element was identified and described, photographed, and assigned a temporary number. The element's condition was assessed and recommendations made for rehousing and curation. The most exciting result was the confirmation that Iris' feminine name was apropos. An embryo hinted at in the original description of the material was rediscovered in one of her rib blocks and is currently being studied. Iris and the other two members of the *Shonisaurus popularis* type series are now accessible to researchers.

Keywords: Nevada, paleontology, ichthyosaurs
<https://osf.io/fnqh2/>

Software for Fast High Quality Transcription of Millions of Digitized Herbarium Specimens

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DC-01 DemoCamp

Museums all around the world have digitized their collection, are digitizing their collection, or are planning to digitize their Herbarium and / or Entomology collections. The collections normally consist of millions of specimens, making both the digitization and the transcription process complex and costly. Different types of applications and software is available with which the information on the herbarium sheet can be captured and stored. The specimen data is made available via Internet and can be assessed from all over the world.

Currently some Museums are transcribing the information on the Herbarium sheets by themselves or by open source platforms with own personnel or with volunteers. Duration is lengthy and the quality of volunteers is not always consistent.

DETA, the Data Entry and Transcription Application is specifically designed to transcribe information from Herbarium and Entomology specimens fast and with high quality. Depending on the information to be captured the speed is 60 - 120 specimens per hour with a quality of (handwritten) input of more than 99% can be achieved. Different Museums have used DETA either via Alembo, via Picturae or by themselves.

DETA is aimed at delivering the highest possible quality of transcription. The quality is reached because of different levels of control and quality verification. The applications can have up to 5 check- and feedback levels. Normally two levels is sufficient to reach a quality of 99% correct. Each level and each controller can specify the sample size to review.

By making use of experienced transcribers from Alembo, an incredible speed of processing of more than 60 - 120 specimens per hour can be reached. The transcribers have currently captures herbarium sheets for:

- Naturalis Leiden, The Netherlands
- The Smithsonian Institution's National Museum of Natural History Washington
- Meise Plantentuin Belgium
- KEW Gardens London
- Universite Claude Bernard in Lyon
- and many more

The Naturalis Project transcribing 3,000,000 specimens started in september 2013 and was finished may 2015. Appr 40 transcribers in the peak of the project.

Keywords: Transcribing; Software; Herbarium collections; Entomology collections; Digitization
<https://osf.io/8mvfj/>

Fast Prototypes for Collection Data Enhancement: GBIF Issue Explorer, Location and Name Matching Using approximate Strings

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DC-01 DemoCamp

We developed several web applications in R/Shiny to test methods and user interfaces for enhancing records in the collections. The app GBIF Issue Explorer allows collection managers and researchers to navigate data issues identified by GBIF. The tool displays additional relevant information, like coordinates and a map for spatial issues, to make it easier to determine the source of the issue and reduce the complexity of navigating these reports.

Another app we developed, Location Matching, uses approximate string matching to simplify the cleanup of location strings transcribed from digitized herbarium sheets. Many location strings in the sheets were not legible or were obscured by the specimen. Finding a correct string manually was taking too much time. The app takes the strings tagged with problems as matches them to known location strings from 2 databases.

The last app in this demo. Name Match, finds species name in an accepted taxonomy. The app takes identification strings from specimen labels, which can be written in a variety of ways, and tries to find a match in the taxonomy. If the species name is not found, it finds the closest match using approximate string matching for manual verification.

The approach of developing prototypes quickly in this framework will allow us to expand the tools available to enhance the specimen records and reduce development cost and time.

Keywords: transcription, string matching, taxonomy, GBIF, occurrence records, R/Shiny
<https://osf.io/pks6u/>

A New Approach to Digitizing and Imaging the Harvard University Herbaria Wood Slides

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GS-02 General Session Poster Presentations

This poster presents the ongoing project to digitize and image the wood slide collection from the Harvard University Herbaria. The HUH wood slide collection is a diverse repository of primarily tropical wood species from all over the globe comprised of 30,000+ microscope slides collected approximately between 1890 and 1975.

The goal of this project is to bring awareness to this fantastic collection to myriad disciplines and to develop a system that utilizes cutting edge technology to make this resource available to all researchers. The poster will outline the workflow created to image and digitize this collection presents, as well as highlight some of the unique challenges this collection poses.

Keywords: Wood slides, digitization, imaging
<https://osf.io/ba8dt/>

Crowdsourcing Digitization and Curation: Transformative Models for Community Science Engagement Connecting Natural History Collections to Biodiversity Research and Education

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SY-04 Crowdsourcing Digitization: Partnerships, Platforms, And The Worldwide Engagement For Digitizing Biocollections (Wedigbio) Event.

Biological collections are uniquely poised to inform the stewardship of life on Earth in a time of cataclysmic biodiversity loss. Efforts to fully leverage collections are impeded by a lack of trained taxonomists and collection expertise coupled with a lack of interest and engagement by the public. We provide two models of crowd-sourced data collection and curation projects that produces high quality taxonomic data sets and rapidly enhanced curation while empowering community scientists through real contributions to science. These projects are a collaboration between collection professionals, taxonomists, community science experts, teachers and students from universities and K–12,

notwithstanding the over 12,000 volunteer community scientists. Two case studies are briefly presented. 1) Spanning four years, the annual Worldwide Engagement for Digitizing Biocollections (WeDigBio) Event at Field Museum alone has included over 1,000 volunteers and community scientists tackling over 30,000 objects or digital records, from processing moss specimens, transcribing data about mice from the Marshall Islands, to georeferencing insect records. 2) In collaboration with Zooniverse, we showcase an online tool that allows community scientists to measure digital images of specimens of a hyper-diverse group of early land plants from a biodiversity hotspot. More than 11,000 participants from the general public contributed over 100,000 data points, which is demonstrably aiding taxonomists working toward establishing conservation priorities and accelerating increased accessibility to biodiversity data. Both case studies provide opportunities for public participation in authentic science research. The project's educational component helps move youth toward engaging in scientific thinking and has been adopted by several universities into curriculum for both biology and non-biology majors.

Keywords: community science, digitization, natural history collections, plants
<https://osf.io/zpsx6/>

Osteological Ink: Comparing Pens for use in Labeling Osteological Collections

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GS-02 General Session Poster Presentations

Labeling bones with a catalog number is an essential practice within museum osteological collections. While archival ink types have been analyzed for best use, the question of which pen type is best is variable and subject to personal preference. This is often because the more desirable and higher quality pens for use on bone surfaces also come with drawbacks, such as frequent clogging or leaking while in use. Other pens, which may not be quite as high quality and therefore do not write on bone surfaces as well, especially when bones are greasy, may be more desirable because they continue to work without problems for a longer period of time, therefore decreasing costs for museums.

The University of Wisconsin Zoological Museum houses over 20,000 skeletons for research and teaching purposes in zoology and zooarchaeology. Labeling the bones within this collection with the appropriate catalog number is vital to the organization and care of the collection, as well as for any research conducted that utilizes the collection. In 2018 alone, over 300 skeletons were processed and labeled, so at this institution as well other many others, using proper high-quality archival ink and pens is crucial in maintaining the collections.

To generate a baseline comparison for archival pens, we examined longevity, price, quality of line, and usability on different bone surfaces. The pen selection reflects a range of traditional and modern options that include traditional drafting pens, refillable fineliners, and disposable pens that collectively represent a variety of nib type and size.

Keywords: Pens, Labeling, Archival, Products, Comparison, Osteology, Bones
<https://osf.io/hfrxu/>

Envisioning Yale's New Home for Natural History: the Yale Peabody Museum

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GS-01 General Session Oral Presentations

Following the Peabody's 150th anniversary in 2016, the Museum announced a major renovation project that will reinvent the Peabody for the 21st century and beyond, further establishing the Museum as a home for cutting-edge research, extraordinary education, and breathtaking exhibitions. This is the first comprehensive renovation the Peabody building on Whitney Avenue in 95 years. The Peabody is part of a three-building complex with the Kline Geology Laboratory and the Class of 1954 Environmental Science Center. The Peabody and most of the lower level of Kline Geology Laboratory will be renovated with new exhibits, teaching spaces and space for the Museum's expansive research collections, and an interior courtyard with a four-floor building will be added to the footprint. In addition to the alterations in New Haven, 20,000 square feet of collections storage and management spaces will be renovated at Yale's West Campus for our Anthropology and History of Science and Technology Collections.

In New Haven, the juxtaposition of the Peabody to the Anthropology, Ecology and Evolutionary Biology and Geology & Geophysics departments and the School of Forestry and Environmental Studies uniquely sits Peabody with its allied departments for regular engagement with their faculty and students. At West Campus, our Anthropology and History of Science and technology collections are adjacent to the Yale University Art Gallery holdings and the shared conservation laboratory and conservation scientists of the Institute for the Preservation of

Cultural Heritage. On both Central Campus and at West Campus, we will be testing new models of environmental management and energy usage of our newly created spaces.

Keywords: Yale, Peabody, Renovation, Collections
<https://osf.io/fg87d/>

Internship Cataloguing Utah Dinosaurs

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SY-07 Interns And Young Professional Showcase (Poster Session)

The Field Museum had a large backlog of dinosaur specimens from the Late Cretaceous in Utah. There were hundreds of specimens which were collected over the past two summers. These fossils had been prepared and identified, but had not been catalogued, and lacked proper housing, labels and a place in the collection. As part of the Women in Science Internship program, I worked with four other interns to catalog and house these specimens.

We entered specimen data into the 4D database, assigned a catalog number, printed a label, and wrote the catalog number on the fossil. We created custom boxes for each fossil, using an ethafoam lined acid-free cardboard box, and added ethafoam supports when necessary. We organized the fossils in drawers by anatomy-head to tail with forelimbs separate from hindlimbs. Finally, we integrated the fossil specimens into the collection by taxonomy and printed labels for the drawers and cabinets.

At the conclusion of our six week internship, we had successfully curated into the collection over 600 juvenile *Eolambia caroljonesa* bones, an adult *E. caroljonesa* specimen, an orodrominae, and the holotype of *Siats meerkerorum*, which

had been cataloged, but was in an office and needed proper housing and a spot in the collection. As part of the Women in Science internship, we made a video about our internship experience. The videos are used to showcase our work to donors and the public.

The Women in Science internship inspired me to return for a second internship after I graduated from college. This three-month internship gave me the chance to work in the dinosaur collection again, as well as the fossil fish and fossil mammal collections, and learn more about collections management. I participated in some of the other aspects of caring for a collection and learned more about the overall care of a collection. I was able to do several projects, including inventorying the dinosaur and oversize collection, cataloguing *Palaeoxyris* spp., fossilized shark egg cases, and reorganizing that collection, and compiling all the fossil vertebrate drawer and cabinet label files in one location. These experiences led me to apply for the Collections Assistant job I have now. Without these internships, I would not have known I enjoyed this type of work or had the experience necessary to get the job.

Keywords: internship, dinosaurs, fossils
<https://osf.io/4eh9p/>

Evaluating Fungal Data from Canadian Parks

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GS-02 General Session Poster Presentations

The Canadian National Mycological Herbarium (DAOM) in Ottawa, Canada, houses ~350,000 fungal specimens spanning >100 years globally. The fungarium includes all groups from rusts to hyphomycetes and mushrooms emphasizing Canadian taxa; especially phytopathogens. Digitization of the herbarium began in the 1980s with dBase IV. Barcoding vouchers and databasing all label collection data from the fungarium was completed in 2018. From these data, collections from national and provincial parks now can be ascertained and evaluated. Four focused mycological surveys were conducted in Thousand Islands, Kouchibouguac, Riding Mountain, and Waterton Lakes National Parks in the 1970s and 80s in conjunction with Parks Canada. The surveys employed ‘data banks’, published reports and deposited accessions in the DAOM herbarium. There were also smaller park expeditions which deposited vouchers. Approximately 10,000 records represent Canadian park collections, a small proportion (~7%) of the overall Canadian collections. Of these records ~30% are from provincial parks and ~70% from national parks. From this data it can be roughly gauged which parks are best represented, the range of fungi collected and the nature of gaps in the data. There are 60 type specimens from the parks which have been imaged. A comprehensive collecting history from parks represented in the data has not been possible until now.

Keywords: Canada, fungi, parks, surveys, digitization, herbarium

<https://osf.io/b2jr7/>

Improving Environmental Conditions in the Archaeology Collections at Bishop Museum

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GS-02 General Session Poster Presentations

As part of a National Endowment for the Humanities (NEH) Sustaining Cultural Heritage Collections grant to develop a Master Preservation Plan for the Archaeology Collections at Bishop Museum, implementation funds were used to address issues of visible light (LUX), ultraviolet radiation (UV), and heat/infrared radiation (IR) within the main collections storage spaces and work areas that were most at risk. This poster discusses the work that was conducted to address these issues through sustainable passive and active measures that fall within reasonable resource and capacity limits. The poster also shows the initial results of the project.

Keywords: collections environment, improvement, archaeology collections
<https://osf.io/g7y5z/>

CSIRO's National Biological Collections as 21st Century Research Infrastructure

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GS-01 General Session Oral Presentations

Understanding the world's biodiversity to conserve species, maintain ecosystem services, identify genetic resources, mitigate biosecurity threats and monitor environmental condition, is a massive global challenge. In the 21st century, biological collections have a key role to play in delivering science-based solutions to these problems. At CSIRO's research collections, digital data mobilisation and integration, as well as the addition of genomic, phenomic and cultural data layers to the 12+ million specimens, is being combined with new data analytics, to increase the sophistication and extend the application and impact domains of collections-

based science. This transformation is generating a new and compelling value proposition for the collections as critical national research infrastructure. Examples include deployment of AI-based species identification tools, metagenomic analysis of pollinator networks to understand effects of landuse change, development of genomic reference datasets for eDNA-based species monitoring and understanding the genetic architecture and evolution of adaptive traits.

Keywords: Biological collections, research infrastructure, impact, genomics, phenomics, digital
<https://osf.io/pf9bk/>

The Zoological Collections at the Instituto De Biología, Universidad Nacional Autónoma De México (IB UNAM)

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GS-01 General Session Oral Presentations

One of the most important challenges in science is the understanding of the biological diversity in the planet. In megadiverse countries like Mexico, this task is considerably important due to its extraordinary biological richness. The Instituto de Biología at the Universidad Nacional Autónoma de México (IB UNAM) was founded in Mexico City in 1929, and currently hosts the national biological collections. In particular, the IB UNAM contains the following 10 zoological collections: helminths, insects, molluscs, fishes, mites, amphibian and reptiles, arachnids, birds, crustaceans and mammals. In this talk we give details about the facilities and the biological material deposited in the Zoological Collections at IB UNAM. In these collections there are

deposited more six million voucher specimens, with the National Collection of Insects (CNIN) being the largest one with more than five million deposited specimens. A total of 32 researchers and 20 academic technicians are based at the Zoological Collections, where they actively collaborate both national and internationally. We welcome the visit of national and international taxonomists and students for examination of biological material. More details about the zoological collections at IB UNAM are found in its website (www.ib.unam.mx).

Keywords: Scientific collections, Mexico, Zoology.
<https://osf.io/pcxm5/>

Small Entomology Collections: An Update on their Status and Contributions to Collections-Based Research

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SY-13 SCNet Symposium: No Collection Left Behind: Research Contributions of Small Collections

In this presentation, we review the status of small entomology collections in the United States with regard to their specimen holdings, digitization efforts, and contributions to research. We first summarize criteria used to delineate small entomology collections and how they compare with some of the largest collections in the US. We then make comparisons among these and other public collections from North America, and examine their digitization efforts to date. Digitization productivity for these small collections, including the number of transcribed records, images delivered, and number of records that are research ready are given. We will report how specimen-level data from small entomology collections can provide a rich resource for

regionally-focused research and beyond. We will conclude with examples and a discussion on the potential of small entomology collections to play a larger, more complementary role in collections-based research.

Keywords: insects, biodiversity, research
<https://osf.io/5hfqu/>

Preservation of Animal Genetic Resources: Current Practices and Future Opportunities

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GS-01 General Session Oral Presentations

Genetic samples require specialized storage to maintain their viability, but the manner by which they are initially preserved also greatly affects their utility in future research. Researchers often choose tissue preservation methods based on planned study goals and practical considerations associated with the collecting event, such as the availability of cold-storage equipment in the field or regulations associated with transporting preservatives or samples. Given survey data collected from genetic resource collections associated with natural history museums, we review the most commonly used methods of initial preservation for animal tissue samples. A method that allows the future establishment of cell lines in amphibians is also outlined as an alternative or addition to current practices. While many major museums do not currently have the

facilities or staff to establish cell lines, they do contain the infrastructure to cryopreserve samples if initial preservation protocols are adapted. Fresh tissue prepared using the “tissue piecing” method can be maintained indefinitely in liquid nitrogen, thereby allowing fibroblast cell lines to be established and cryopreserved at a later date. Unlike other consumable samples (e.g., tissue, DNA), cell lines would provide a continual source of genetic material for a wide variety of purposes, including both research projects and species propagation using Assisted Reproductive Technologies.

Keywords: cryopreservation, cell lines, tissue sampling
<https://osf.io/sv6ab/>

Transparency about Origins and Uses: Tracking Permits and Other Legal Compliance Documentation in Collection Management Systems

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GS-01 General Session Oral Presentations

There are a growing number of domestic and international legal issues confronting biodiversity collections requiring that multiple stakeholders have access to information that documents the legal aspects of a specimen’s ownership or restrictions regarding its use in research. In addition, an increasing number of permissions are required to collect, receive, and transport specimens domestically and internationally for the purposes of loans or gifts. As a result, numerous legal compliance documents are associated with a specimen’s history, including permits, agreements,

certificates and other miscellaneous supporting documentation. It is well understood, based on over 50 years of experience, how to manage and share the scientific data associated with biodiversity collections. It is similarly well documented how to use collections management systems to support collections business practices in tracking the movement of specimens in and out of collections. There are, however, no standards for data associated with legal compliance documentation, and the required data, metadata, and business practices are both poorly understood and largely unimplemented in collections management systems. Key aspects of a specimen’s history will not be easily accessible to collection managers or to potential users of those specimens if compliance document records remain outside of the digital infrastructure of collection management systems. Given the new legal landscape, it is clear that digital solutions for tracking records at all stages of a specimen’s life cycle are needed. We demonstrate how the Museum of Comparative Zoology is linking permits and other legal compliance documentation to specimens and to transactions, such as accessions and loans, to facilitate access and transparency.

Keywords: Permits, Database, Informatics
<https://osf.io/v6nxg/>

Kit-Bashing Camera Code: Lessons in Developing Auto-Assist Tools to Compliment the GIGAMacro Photography System

Alex **Zimmerman**

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SY-05 Managing And Digitizing Large Collections

Recent advancements in photography hardware and software, such as the GIGAMacro Photography System, allow collections workers

to capture thousands of high-resolution, wide focal-depth photographs a day with minimal manual effort. The front-end work of camera setup is the most time-consuming task, with the bulk time spent specifying where in the tray the camera should photograph. The GIGAMacro software package does not include a tool to reduce or help automate this setup, so we developed our own. The tool we designed is an intuitive user interface that is linked to scripted processes to semi-automate the setup process. On average, this tool has decreased our camera setup time by 98.5%. The development process involved a feedback loop of gathering comments and suggestions, implementing features, and testing with different end-users. The resulting auto-assist tool is designed to be accessible for workers with varying levels of experience and is wholly contained in one Excel document for portable use.

We chose to develop our camera setup tool in Excel due to broad user familiarity and presence of necessary supporting components. Both advantages greatly shortened development time. Additionally, Excel allowed us to change measurement or calculation numbers for the camera on the fly without having to recompile and/or install a new executable. The files that contain the camera setup runs (now numbering in the hundreds after two years) can be saved and reloaded easily on any of our network computers.

This Excel-based, custom tool compliments the extensive automated process that GIGAMacro provides. The tool fits into the front-end

workflow of the entire digitization process, reduces manual setup time by almost two orders of magnitude, and can be employed by other research collections interested in digitizing thousands of microfossils. The software tool is freely available at <<https://github.com/alex-zimmerman/GigaMacroAssist>> along with user notes on how to employ and/or adapt the tool in other collections.

Keywords: auto-assist tool, GIGAMacro, microfossil photography
<https://osf.io/qepmv/>

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Specimen Spotlights

The Dying Robins of Michigan State University

Laura M. Abraczinskas, abraczi1@msu.edu
Michigan State University Museum
10:50:00 AM, Wednesday May 29th

Tenacious - The Resilient Nature of the Black-Footed Ferret (*Mustela nigripes*)

Corey A. Anco, coreya@centerofthewest.org
Buffalo Bill Center of the West
Draper Natural History Museum
11:15 AM, Wednesday May 29th

Zinacantec Tunic

Lori Benson, lori-benson@usa.net
Independent Museum Professional
11:40 AM, Wednesday May 29th

Thick-Billed Parrot (*Rhynchopsitta pachyrhyncha*)

Serina Brady, ssbrady3@unm.edu
University of New Mexico
10:55 AM, Wednesday May 29th

Sea Otter and Abalone

Ann M. Bishop, abishop@mlml.calstate.edu
Moss Landing Marine Laboratories
11:10 AM, Wednesday May 29th

Québec's Only *Gentainella quinquefolia*

Nadia Cavallin, ncavallin@rbg.ca
Royal Botanical Gardens
9:25 AM, Wednesday May 29th

***Anchiornis huxleyi*: The Feathered Dinosaur that Flew the Coop**

Linsly J. Church, churchl@carnegiemnh.org
Carnegie Museum of Natural History
4:25 PM, Thursday May 30th

Confounding Collections: The Payne of Stewardship

Kimberly J. Cook, kijucook@iu.edu
Indiana Geological

and Water Survey

9:20:00 AM, Wednesday May 29th

Giants of the Ordovician Seas

Patricia Coorough Burke,
coorough@mpm.edu
Milwaukee Public Museum
8:35 AM, Wednesday May 29th

FMNH2211: The Hard Life of a Young Tyrannosaur

Thomas M. Cullen, tcullen@fieldmuseum.org
Field Museum of Natural History
4:05:00 PM, Thursday May 30th

The Discovery of Darwin's Sand Dollar

Jessica D. Cundiff, jcundiff@oeb.harvard.edu
Museum of Comparative Zoology
Harvard University
8:40 AM, Wednesday May 29th

Man's Best Friend: A 7000 Year Old Dog Burial in the Great Basin

Rachel K. Delovio,
rdelovio@nevadaculture.org
Nevada State Museum
11:35 AM, Wednesday May 29th

19-Ton Lake Superior Copper Nugget

Helen J. DeMarsh, hjdemars@mtu.edu
Michigan Technological University School of
Forest Resources and Environmental Sciences
4:45 PM, Thursday May 30th

Stuffing a New Endangered Southern Cassowary

Alison P. Douglas, alihilldouglas@gmail.com
Queensland Museum
1:55:00 PM, Thursday May 30th

The Boaz and Anderson Mills Mastodon(s)

Carrie A. Eaton, carrie@geology.wisc.edu
University of Wisconsin

Geology Museum

8:45 AM, Wednesday May 29th

Feather Earring from Northern California

Laura Eklund, leklund@calacademy.org

California Academy of Sciences

2:50:00 PM, Thursday May 30th

A Q?rius Pangolin: Odd Mammal, Perfect Teaching Tool

Kelsey Falquero, falquerok@si.edu

Smithsonian Institution

Collections Program

National Museum of Natural History

1:40 PM, Thursday May 30th

Orca O319 - The Journey from the Beach to the Exhibit Hall

Maureen (Moe) Flannery,

mflannery@calacademy.org

California Academy of Sciences

11:30 AM, Wednesday May 29th

A Glass Model of Slug Anatomy

Jochen Gerber, jgerber@fieldmuseum.org

Field Museum of Natural History

2:15:PM, Thursday May 30th

Enigmatic Dinagat Gymnure

Juan Carlos T. Gonzalez,

jtgonzalez@up.edu.ph

University of the Philippines Los Baños

Museum of Natural History

1:50 PM, Thursday May 30th

A Tale of a Whale

Aren M. Gunderson,

amgunderson@alaska.edu

University of Alaska Museum

11:05 AM, Wednesday May 29th

The Arctos Specimen Standard

Aren Gunderson, amgunderson@alaska.edu

University of Alaska Museum

11:25 AM, Wednesday May 29th

Every Label Tells a Story...or Two, or Three

Tonya M. Haff, tonya.haff@csiro.au

Australian National Wildlife Collection

3:35 PM, Thursday May 30th

***Rhododendron yakushimanum* 'Koichiro Wada'**

Yvette B. Harvey, yvetteharvey@rhs.org.uk

Mandeep Matharu,

mandeepmatharu@rhs.org.uk

Royal Horticultural Society

3:10 PM, Thursday May 30th

CM 76867, *Fedexia striegeli*: Pittsburgh's Late Paleozoic Treasure

Amy C. Henrici, henriciac@gmail.com

Carnegie Museum of Natural History

4:35 PM, Thursday May 30th

The Murchison Meteorite: 50 Years of Discovery

James L. Holstein,

jholstein@fieldmuseum.org

Field Museum of Natural History

8:55 AM, Wednesday May 29th

Banks' Collector and the Aboriginal Guide: An Early Eucalypt Specimen from the Colony of Sydney

Shelley A. James,

shelley.james@rbgsyd.nsw.gov.au

Peter G. Wilson,

peter.wilson@rbgsyd.nsw.gov.au

Royal Botanic Gardens and Domain Trust

National Herbarium of New South Wales

2:55 PM, Thursday May 30th

Lord Howe Stick Insect: Back from Extinction?

Debbie Jennings, debbie.jennings@csiro.au

Federica Turco, federica.turco@csiro.au

CSIRO, Australian National Insect Collection

10:30 AM, Wednesday May 29th

Chameleon Specimen

Helen Kairo, hezhu1@gmail.com
Anatomika
10:40 AM, Wednesday May 29th

**The Precious and Beautiful
Gynandromorph**

Laurel Kaminsky, lkaminsky@flmnh.ufl.edu
Florida Museum of Natural History
McGuire Center for Lepidoptera and
Biodiversity
10:25 AM, Wednesday May 29th

***Amerodectes jonesborensis*: Who 'mite' that
be?**

Kevin J. Krajcir,
kevin.krajcir@smail.astate.edu
Than J. Boves, tboves@astate.edu
Arkansas State University
2:30 PM, Thursday May 30th

**American Purple Gallinule: An Unlikely
Representative of Northwoods Biodiversity**

Mollie Krebs, mollie@cablemuseum.org
Cable Natural History Museum
11:50 AM, Wednesday May 29th

A Collaborative Path to Science

Bruce H. Lauer,
bruce@lauerfoundationpse.org
Rene' L. Lauer, rene@lauerfoundationpse.org
Lauer Foundation for Paleontology
4:30 PM, Thursday May 30th

**Saving Slimy Salamanders: Using Modern
Techniques on Legacy Collections**

Amanda N. Lawrence, lawrencea@si.edu
National Museum of Natural History
Anthropology
10:35 AM, Wednesday May 29th

**Family Tree: Preserving a Legacy, a
Collection, and the Coral Reefs**

Devon E. Lee, dlee@amnh.org
American Museum of Natural History
2:20 PM, Thursday May 30th

Amethyst *Allosaurus*

Carolyn G. Levitt-Bussian,
clevitt@nhmu.utah.edu
Natural History Museum of Utah
4:20 PM, Thursday May 30th

**An Extremely Rare Specimen Collected in
Jodavies Co. in Northwest Illinois.**

James Louderman,
jlouderman@fieldmuseum.org
Field Museum of Natural History
2:35 PM, Thursday May 30th

**From Finwhale to Finishing - The
Redevelopment of UMZC**

Mathew W. Lowe, mwl34@cam.ac.uk
University Museum of Zoology, Cambridge
1:35 PM, Thursday May 30th

A Very Rare Arboreal Spiny Rat

Andrés J. Lozano-Flórez,
alozano@humboldt.org.co
Instituto de Investigación en Recursos
Biológicos Alexander von Humboldt
1:45 PM, Thursday May 30th

**A New Plant Genus from a Cabinet of
Curiosities**

Emily Magnaghi,
emagnaghi@calacademy.org
California Academy of Sciences
3:05 PM, Thursday May 30th

***Camellia x williamsii* 'St. Ewe'**

Mandeep Matharu,
mandeepmatharu@rhs.org.uk
Yvette Harvey, yvetteharvey@rhs.org.uk
Royal Horticultural Society
9:40 AM, Wednesday May 29th

**The Tully Monster: What Can We Learn
from a Strange 300 Million Year Old
Fossil?**

Paul Mayer, pmayer@fieldmuseum.org
Field Museum of Natural History
8:15 AM, Wednesday May 29th

The Marvelous Mystery of Micromounts

Cailin E. Meyer, meyerca@si.edu
 Smithsonian Institution
 National Museum of Natural History
 9:05 AM, Wednesday May 29th

Squee! Ahhh! What, No!?! And Other Reactions to a Fuzzy Rock

Jess Miller-Camp, jessmc@iu.edu
 Indiana University - Bloomington
 Earth & Atmospheric Sciences
 8:50 AM, Wednesday May 29th

***Gymnocactus subterraneus*: A Tale of Two Types**

Mare Nazaire, mnazaire@rsabg.org
 Rancho Santa Ana Botanic Garden
 3:50 PM, Thursday May 30th

Crocodile Icefish from the Stomach of Antarctic Toothfish

Oliver D. Orr, oliver.orr@yale.edu
 Yale Peabody Museum of Natural History
 2:05 PM, Thursday May 30th

Using Your Head: MPM 8111 and the Pachycephalosaur Debate

Kathryn Pauls, paulsk@mpm.edu
 Milwaukee Public Museum
 4:10 PM, Thursday May 30th

Revitalizing Heirloom Maize through Whisky

Taryn Pelch, tpelch@mobot.org
 University of Missouri - St. Louis
 9:30 AM, Wednesday May 29th

Steinbeck/Ricketts Starfish

Chrissy Piotrowski,
 cp Piotrowski@calacademy.org
 California Academy of Sciences
 10:15 AM, Wednesday May 29th

Hamilton and The Sickener

Amber R. Reaney, reaneyam@vt.edu
 Jordan Metzgar, metzgar@vt.edu

Virginia Tech, Massey Herbarium
 3:45 PM, Thursday May 30th

Two Botanists and an Artist Walk into the Desert...

Tiana F. Rehman, trehman@brit.org
 Barney Lipscomb, barney@brit.org
 Botanical Research
 Institute of Texas
 9:15 AM, Wednesday May 29th

Specimen Woods and Trunk Photographs Illustrating the Tree Flora of Illinois, Created by Benjamin T. Gault, 1899-1901

Dawn Roberts, droberts@naturemuseum.org
 Chicago Academy of Sciences
 Peggy Notebaert Nature Museum
 3:00 PM, Thursday May 30th

3D Prints Tell Human Stories

Katherine Roberts, robertska@si.edu
 Smithsonian Institution
 National Museum of Natural History
 Collections Program
 2:45 PM, Thursday May 30th

The Narborough Island Tortoise

Lauren Scheinberg,
 lscheinberg@calacademy.org
 California Academy of Sciences
 10:45 AM, Wednesday May 29th

The Mummy's Lichen at the Farlow Herbarium

Michaela Schull,
 mschull@oeb.harvard.edu
 Harvard University Herbaria
 9:35 AM, Wednesday May 29th

A Lonely Branch on a Mountain Top

Vijayakumar Seenapuram Palaniswamy,
 vijay_rhaco@yahoo.com
 Kartik Shanker Indian Institute of Science,
 kshanker@iisc.ac.in
 The George Washington University
 3:30 PM, Thursday May 30th

Field Museum's First New Dinosaur

William F. Simpson,
simpson@fieldmuseum.org
Field Museum of Natural History
4:15 PM, Thursday May 30th

(Re)blazing Stars in the Mississippi Alluvial Plain of Arkansas

Diana L. Soteropoulos,
diana.soteropo@smail.astate.edu
Arkansas State University
3:40 PM, Thursday May 30th

How Much Research Could a Bat Bug Bolster, If a Bat Bug Could Bolster Research?

Benjamin Spitz,
benjamin.spitz@smail.astate.edu
Arkansas State University
11:20 AM, Wednesday May 29th

More Than Just a Pretty Picture: Paleoart as a Tool to Teach Evolution

Adrienne M. Stroup,
astroup@fieldmuseum.org
Field Museum of Natural History
9:10 AM, Wednesday May 29th

Don't Throw Your Specimens Out of a Window: Resurrecting IU's Lost *Megalonyx jeffersonii*

Polly R. Sturgeon, proot@indiana.edu
Gary J. Motz, garymotz@indiana.edu
Indiana Geological and Water Survey
Indiana University
4:40 PM, Thursday May 30th

***Dictyorhabdus priscus*: What is it and What Can it Teach Us?**

Ellen Thomas, ethomas@wesleyan.edu
Wesleyan University
Earth & Environmental Sciences
4:00 PM, Thursday May 30th

Rediscovering Iris the Ichthyosaur: the *Shonisaurus popularis* Type Specimen at the Nevada State Museum, Las Vegas

Sali A. Underwood,
sunderwood@nevadaculture.org
Paige E. dePolo,
paige.depolo@nevada.unr.edu
Nevada State Museum
11:45 AM, Wednesday May 29th

Beecher's Trilobite Bed

Jessica Utrup, jessica.utrup@yale.edu
Yale Peabody Museum of Natural History
8:30 AM, Wednesday May 29th

A Curious Cardinal

Jacquelyn Whisenant,
jacki.whisenant@gmail.com
Emily Halverson, elannoye@wisc.edu
University of Wisconsin-Madison
Zoological Museum, Wisconsin Insect
Research Collection
2:00 PM, Thursday May 30th

A Cambrian Can of Worms: Fossil Preservation and Best Practices in Collections

Anna F. Whitaker,
annawhitaker01@gmail.com
University of Kansas
Museum Studies & Biodiversity Institute
8:25 AM, Wednesday May 29th

He Mapped the Ancient Seas and Fathomed the Geologic Past

Russell D. White, tim.white@yale.edu
Yale Peabody Museum of Natural History
8:20 AM, Wednesday May 29th

Blue Banded Bees as Biosensors

Andrew G. Young, andrew.young@csiro.au
CSIRO National Research Collections
Australia

2:40 PM, Thursday May 30th

A New Species of Phytophagous Braconid Wasp (Doryctinae: *Allorhogas*) Attacking Fruits/Seeds on *Miconia chamissois* Naudin

Alejandro Zaldívar-Riverón,

azaldivar@ib.unam.mx

Universidad Nacional Autónoma de México

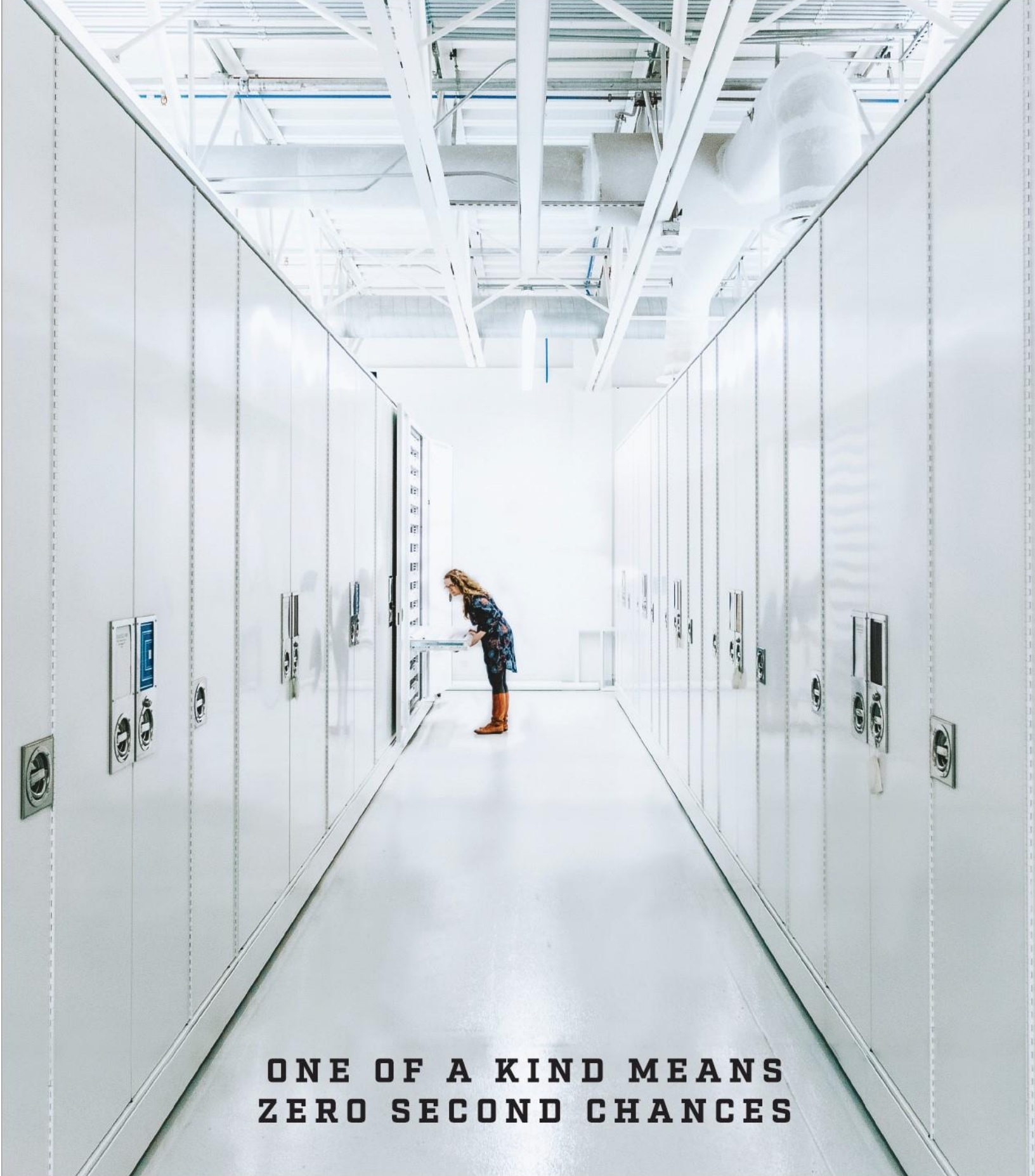
2:25 PM, Thursday May 30th

The Vampire Squid from Hell

Christine Zorn, christine.zorn@mfn-berlin.de

Museum für Naturkunde Berlin

10:20 AM, Wednesday May 29th



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